DOCUMENT RESUME

ED 162 645 IR 006 223

AUTHOR Johansen, Robert; And Others
TITLE Group Communication Through Computers. Volume 5: Effects on Working Patterns. Final Report.
INSTITUTION Institute for the Future, Menlo Park, Calif.
SPONS AGENCY National Science Foundation, Washington, D.C.
PUB DATE Feb 78
GRANT APR 76-00512
NOTE 195p.; For related documents, see ED 110 012-013 and IR 006 221-223

EDRS PRICE MF-$0.83 HC-$10.03 Plus Postage.
DESCRIPTORS *Computers; *Conferences; Energy; *Networks; *Productivity; Research Projects; *Telecommunication
IDENTIFIERS *Computer Conferences

ABSTRACT

This project funded by a grant from the Research Applied to National Needs Division of the National Science Foundation explored the measurable or potential effects of computer conference usage on the productivity of energy research groups. The timeliness of their work and the high level of their communication needs made this an appropriate group for the study, and the usage of computer conferencing by 14 selected groups ranging in size from six to 32 members was tracked for a period of about 15 months. This report includes (1) a summary of the relevant literature on research productivity, an approach to measuring research productivity by tracking changes in working patterns, and an explanation of the general research design; (2) identification of three major styles of usage adopted by the groups--the exchange, the community, and the seminar; (3) delineation of working patterns; (4) documentation of factors affecting the success or failure of a computer conference and guidelines to assist future conference organizers; and (5) a discussion of both the regulatory and organizational policy issues which are suggested by the results of the project. Appendices contain instrumental tools used and documentation supporting the findings. (Author/RAO)

GROUP COMMUNICATION THROUGH COMPUTERS

Volume 5: Effects on Working Patterns

Robert Johansen
Robert DeGrasse, Jr.
Thaddeus Wilson

The Final Report on Research
Supported by:

National Science Foundation
Grant APR 76-00512
Research Applied to National Needs
Division of Advanced Producivity Research and Technology.

Institute for the Future
2740 Sand Hill Road
Menlo Park, California 94025

February 1978

Report R-41

This report is the fifth volume in a series of Institute for the Future studies of computer conferencing, using the FORUM/PLANET system. The other reports in the series are:

Group Communication Through Computers,

Volume 1: Design and Use of the FORUM System, Jacques Vallee, Hubert Lipinski, and Richard H. Miller, Report R-32, July 1974.

This report describes the technical design and structure of the FORUM computer conferencing system, as well as preliminary experience with the system.

Volume 2: A Study of Social Effects; Jacques Vallee; Robert Johansen; Robert H. Randolph, Consultant; and Arthur C. Hastings, Consultant; Report R-33; November 1974.

This report describes the Institute's approach to social evaluation of computer conferencing, as well as preliminary results from these evaluations.

Volume 3: Pragmatics and Dynamics; Jacques Vallee; Robert Johansen; Hubert Lipinski; Kathleen Spangler; Thaddeus Wilson; and Andrew Hardy, Consultant; Report R-35; October 1975.

Volume 3 is a final report on 28 FORUM conferences held on the ARPA computer network. Five styles of computer conferencing are identified, and 30 "propositions" about findings to date are presented. A bibliography of about 150 items is included.

Volume 4: Social, Managerial, and Economic Issues, Jacques Vallee, Robert Johansen, Hubert Lipinski, Kathleen Spangler, and Thaddeus Wilson, Report R-40, January 1978.

Basic information about costs and organizational issues involved in the use of computer conferencing over a two-year period is included in this report. Limited social evaluations are combined with detailed presentation of usage statistics.

TABLE OF CONTENTS

The opinions expressed in this report are those of the authors and not necessarily the National Science Foundation.

EDITORS

Alison St. Clair
Michael J. Nyhan

GRAPHICS

Roberta Edwards

TYPING AND PRODUCTION

Jeanne Muzzicato
Susanna Thompson
Carreen Jensen

LIST OF TABLES

LIST OF FIGURES

ACKNOWLEDGMENTS

The proposal for this project was written by Jacques Vallee and Robert Johansen, with assistance from Roy Amara and Kathleen Spangler. Allen Shinn and Charles Brownstein of the National Science Foundation, as well as the anonymous proposal reviewers, provided helpful reactions and criticisms of the project idea. Initially a co-principal investigator on the project, Jacques Vallee ended his involvement in late 1976. Robert Johansen was the principal investigator for the remainder of the project, having major responsibility for the conduct of the study and the writing of the report.

Several Institute staff members have played key roles. Jacques Vallee's initial insight and guidance provided a strong beginning. Hubert Lipinski effectively organized the collection and analysis of usage statistics from the computer conference sessions. Thaddeus Wilson assisted in the collection of usage statistics, provided support services for the field test groups, and gave valuable reactions to the final report. Michael Palmer contributed strongly to the questionnaire design and development of productivity measures. Robert DeGrasse organized the analysis of questionnaire responses and computer conference transcripts. He also worked directly with the principal investigator at key decision points in the middle and later stages of the project, as well as the writing of the final report. Jeanne Muzzicato assisted in organizing and producing the bibliography, as well as the final report. Roberta Edwards prepared the charts and graphs, and Alison St. Clair and Michael Nyhan edited the document. Carreen Jensen and Susanna Thompson typed portions of the draft manuscript.

On two occasions early in the project, Donald T. Campbell of Northwestern University provided valuable insights as a consultant to the study design. Roy Amara, Kathleen Spangler, Gregory Schmid, Andrew Lipinski, and Michael Palmer all read one or more drafts of the final report and provided very useful reactions and criticisms.

Finally, we are very appreciative for the participation in the study of the field test groups. While we cannot list everyone here, we are especially grateful for assistance provided by Donald Austin, Gerald Estrin, John Gasper, Bradford Gibbs, Dennis Hall, Jessie Herr, Wasyl Lew, Deane Merrill, Samuel Morris, J. C. T. Pool, Eric Walther, and Peter Ward. To all of the participants, we offer our sincere thanks and hope that our research will be useful to them.

GROUP COMMUNICATION THROUGH COMPUTERS

Volume 5: Effects on Working Patterns

SUMMARY

Preliminary studies have suggested the potential of computer conferencing for improving the productivity of scientists. For example, computer conferencing might facilitate the research process by reducing delays in information exchange, providing precise records of interaction, coordinating the roles of remotely located participants in technical projects, and generally improving the ability to deal with large amounts of information. The goal of this project was to carry out a long-term study of computer conferencing in a field setting.

The report summarized here was funded by a grant from the Research Applied to National Needs Division (RANN) of the National Science Foundation to explore the measurable or potential effects of computer conference usage on the productivity of energy research groups. Energy researchers were selected as an appropriate participant group for the study, based on the timeliness of their work and the high level of their communication needs. Fourteen groups of scientists participated, ranging in size from 6 to 32 members. Their usage of computer conferencing was tracked for a period of about 15 months.

Chapter I summarizes relevant literature on research productivity, develops an approach to measuring research productivity by tracking changes in working patterns, and explains the general research design. The review of research productivity literature produced a list of productivity-related "working pattern" variables which focused on the process of communication in the research environment. By working patterns, we mean the basic structure of when, where, how, and with whom researchers work.

Questionnaires, usage statistics, conference transcripts, and interviews were used in a multiple measures research design to gather data on working pattern changes. For example, data were collected on the frequency with which researchers communicated with colleagues throughout the country and the world, how often they worked at home or outside office hours, and how often they used various media to communicate with distant colleagues. By asking how a researcher altered his or her work patterns during PLANET usage, we encourage readers of this report to judge whether those particular variables are relevant to productivity in their own environment.

USAGE STYLES

These field tests show that usage of computer conferencing varies among different groups who use it. Study participants used computer conferencing for a broad range of tasks including investigating computer network resources, sharing data bases, and scheduling usage of the Communications Technology Satellite (CTS). *Chapter II* identifies three major styles of usage which groups adopted: the *exchange*, the *community*, and the *seminar*. These were revisions of styles previously identified by Institute research.

- The *exchange* groups were characterized by a high need to communicate, participated at constant rates, and had few social exchanges. The NASA group, for example, used computer conferencing to coordinate the activities of all experimenters using the CTS satellite. Over a usage period of nearly two years, 20 participants checked into their conference at least once every two work days.

- The *community* designation arose from groups such as the Interlaboratory Working Group for Data Exchange (IWGDE), in which participants developed greater cohesiveness and interpersonal sharing than in *exchange* conferences. IWGDE researchers used computer conferencing to work together developing data resources needed for specific energy dilemmas.

- *Seminar* style conferences, like the Network Investigators Panel, addressed a specific topic in an intense way for a limited period. These researchers joint-authored a report on computer network resources after participating in a *community* style conference for a year.

Characterizing individual styles of usage was more difficult, though a few generalizations did emerge. Some individuals, for example, checked into the conference regularly, yet seldom contributed; some felt self-conscious about their presentation; and some contributed primarily in the private mode.

EFFECTS ON WORKING PATTERNS

Four aspects of working patterns which could be affected by computer conferencing are delineated in *Chapter III: with whom people work, when they work, where they work*, and *how they work*.

- *With whom people work*--Computer conferencing increased the reported frequency of communication with distantly located researchers and those within other disciplines. These findings raise the possibility of more geographically separated working groups. However, they could also lead to information overload among computer conference participants.

- *When people work*--We found few measurable effects of computer conferencing. Many participants tended to work outside of office hours before the project, and they continued to do so while using PLANET. While one can still argue that computer conferencing could provide more flexibility in working hours, there is no quantitative data from this study to support such an argument.

- *Where people work*--We found a number of instances where computer conferencing added flexibility to where people work, though there were few statistically valid effects. In one example, a researcher who was hospitalized was able to participate in the computer conference before she could return to the office.

- *How people work*--Study participants rated computer conferencing more productive in some instances than mail or telephone. We also found that access to computer conferencing does not necessarily decrease travel, suggesting that the relationship of communication to travel is complex.

Study results showed that overall reported satisfaction with group communication increased during computer conference usage. Also, a variety of tasks were successfully undertaken during the field tests, including joint authorship at a distance, information exchange, data sharing, interfacing with other computer resources and scheduling, planning, and following up face-to-face meetings.

GUIDELINES FOR COMPUTER CONFERENCE USAGE

Chapter IV documents factors affecting the success or failure of a computer conference and offers pragmatic guidelines to assist future conference organizers. Guidelines are arranged in three sections: (1) *Prerequisites for choosing when and when not to use computer conferencing*, such as the importance of a perceived need to communicate; easy access to terminals; adequate introduction to the concept and techniques of computer conferencing; openness to typing; a minimum number of conflicting needs or demands on participants; and a facilitator within organizations adopting computer conferencing. (2) *Tools available to aid the work of a computer conference organizer*. Some are external to the medium (e.g., telephone calls for clearing up problems, mail for draft reports, face-to-face for follow-up discussions). Others, inherent in the medium, include potentials for synchronous conferencing and private messages and use of on-line questionnaires or voting. At a more subtle level, we discuss group-process decisions an organizer must be willing to make during the life of a conference. (3) *Things which could go wrong even if all the prerequisites are met and the organizer does a conscientious and effective job.* These include: frustration over lack of interpersonal feedback, irregular participation, too much structure too soon, and problems deciding when to end the conference.

POLICY IMPLICATIONS

Policy issues arise primarily from the unique options computer conferencing provides in structuring communications activity. *Chapter V* discusses both regulatory and organizational policy issues which are suggested by the results of this project. Because the effects of computer conferencing on working patterns and productivity are so uncertain, it is difficult to forecast policy issues. Nonetheless, some significant policy implications of using computer conferencing with research groups did emerge, including:

- Computer conferencing does not fit current national or international regulatory categories, suggesting further controversy regarding which services should be regulated and how.
- Contrary to initial expectations for computer conferencing, there was little to suggest that this medium will necessarily encourage either organizational decentralization or broadened participation in decision-making.
- While computer conferencing raises the possibility of new supervisory procedures, it also has a potential for violation of privacy through misuse of typewritten transcripts and usage statistics.
- The structure of research administrative structures may be challenged by interorganizational communication provided by computer conferencing; so far, however, it has served primarily to strengthen existing organizations. Funding questions may limit the use of computer conferencing and centralize decisions about who is allowed access to conference discussions.
- While computer conferencing rarely substitutes for travel, it competes favorably with some current uses of mail and telephone.

INTRODUCTION

Preliminary assessments of computer conferencing have suggested its potential for improving the productivity of scientists. Early work, including that reported in previous volumes in this series,* points to the effects of providing scientists with regular access to the new medium. It has been found, for example, that computer conferencing can facilitate the research process by reducing delays in information exchange, providing precise records of interaction, coordinating the roles of remotely-located participants in technical projects, and generally improving the ability to deal with large amounts of information.** While this work suggests that computer conferencing could assist in raising research productivity, no detailed studies of its long-term effects have been performed. Our goal was to carry out such a study in a field setting.

This project was funded by the Research Applied to National Needs Division of the National Science Foundation. Energy researchers were

---

Group Communication Through Computers, including *Volume 1: Design and Use of the FORUM System*, Jacques Vallee, Hubert Lipinski, and Richard H. Miller, Report-32, July 1974; *Volume 2: A Study of Social Effects;* Jacques Vallee; Robert Johansen; Robert H. Randolph, Consultant; and Arthur C. Hastings, Consultant; Report R-33, November 1974; *Volume 3: Pragmatics and Dynamics;* Jacques Vallee; Robert Johansen; Hubert Lipinski; Kathleen Spangler; Thaddeus Wilson; and Andrew Hardy, Consultant; Report R-35; October 1975; and *Volume 4: Social, Managerial, and Economic Issues,* Jacques Vallee, Robert Johansen, Hubert Lipinski, Kathleen Spangler, and Thaddeus Wilson, Report R-40, January 1978.

**These specific effects are reported for teams of geologists using computer conferencing by Jacques Vallee and Gerald Askevold, "Geologic Applications of Network Conferencing: Current Experiments with the FORUM System," in Peter Lykos, ed., *Computer Networking and Chemistry*, American Chemical Society, Washington, DC, 1975, pp. 53-66. Other, similar effects are suggested in articles by Murray Turoff and his colleagues. See, for instance, Murray Turoff, "The Future of Computer Conferencing," *The Futurist*, vol. 9, no. 4, August 1975.

selected as an appropriate participant group for the study, based on the timeliness of their work and the high level of their communication needs. In formulating our approach, we sought to get as close as possible to measures of research productivity. The central question became: What effects does (or could) computer conference usage have on the productivity of energy research groups?

The whole concept of research productivity is littered with uncertainty, and we knew we were unlikely to make any breakthroughs in the field of productivity measurement. Nevertheless, we believed the question of *effects* of new communications media on productivity needed to be addressed and, therefore, sought to identify possible impacts of the introduction of computer conferencing into the energy research environment.

Typically, previous approaches to productivity measurement have relied upon "end products." Great controversy exists over the validity of such approaches, and from the outset we sought to concentrate more on the *process* of research communication than on the *outcome*. Outcome measures are simply too uncertain and often inaccessible in a research project such as we were proposing. Furthermore, they most likely are threatening to study participants. (We did not want the field test participants to see us as evaluators of their performance. If this had happened, we almost certainly would not have been able to complete the project.) We chose, then, to examine effects of computer conferencing on the process of group research, focusing particularly on those aspects which seem related to productivity.

In designing the study, we selected various working pattern variables, such as when people work and where they work, to serve as "proxies" for research productivity. Our findings are phrased in terms of the effects of computer conferencing on these variables. In utilizing the study's results, readers must judge which working pattern variables are most related to productivity in their own environments.

In addition to clarifying our approach to the examination of research productivity in this study, it is important to address the issue of how "computer conferencing" is to be defined. The term is an unfortunate one, since the computer is, ideally, an invisible part of the medium. Also, the

word "conference" too narrowly describes the range of communication which is possible.

Computer conferencing, as we define it, refers to small-group communication facilitated by a computer. It is distinguished from other computer services, such as information retrieval systems, journal systems, or text editors. Also, it refers to *group* communication, rather than the person-to-person capability provided by computer mail or messaging systems.* The Institute for the Future designed two computer conferencing systems, FORUM and PLANET,** in an attempt to provide a simple structure for print-based group communication requiring no computer expertise. They were intended as a research probe, making possible a series of field tests with actual user groups.

In the five years since our work with FORUM began, discussions of computer conferencing have gradually increased in number. Murray Turoff's work at the Office of Emergency Preparedness drew considerable attention and demonstrated a practical utility for computer-conferencing-like

---

*The distinctions between computer mail and computer conferencing are drawn more clearly in Jacques Vallee, *The Outlook for Computer Conferencing on ARPANET and PLATO*, prepared for the Society for General Systems Research meetings, February 1977 (available from the Institute for the Future). In this article, Vallee lists 10 characteristics which are basic to computer conferencing but typically not found in computer mail systems. Included in this list are characteristics such as smooth adaptation from synchronous mode (more than one person present simultaneously) to asynchronous mode, possibility for expansion and replication of discussion structures, and ability to obtain status information on other participants. There are, however, frequent points of overlap between computer conferencing and computer mail, and these seem likely to increase in the future.

**PLANET is simply an optimized version of the FORUM program, developed at the Institute for use on commercial computer networks. The dependability of these networks proved necessary in order to perform the type of field testing described in this report. The documentation for FORUM, described in Volume 1 of this series, is still accurate and can be used as a referent. For examples of the PLANET system as it appears to a user, see Jacques Vallee and Thaddeus Wilson, *Computer-Based Communication in Support of Scientific and Technical Work*, prepared for the National Aeronautics and Space Administration, March 1976.

services.* Other work at the University of Illinois, the University of Michigan, Northwestern University, Bell Canada, and the Department of Non-medical Use of Drugs in the Canadian government** continued to explore the potentials for this kind of communication medium.

There are differences of opinion, however, over what comprises "computer conferencing." In the New Jersey Institute of Technology system, for instance, computerized conferencing is combined with other computer resources, such as a journal system, a text editor, and even a kind of management information system.*** While such a system provides more computer power, it does so at the expense of the simplicity of operation we felt was necessary for an initial exploration of the utility of small group communication through computers. PLANET is a simple system which enables social scientists to explore the potentials of computer conferencing without requiring that they control for the effects of peripheral elements involved in more complex computer services. Our approach has been to base our assessments of computer conferencing on this basic system for group communication through computers.

This study is, to our knowledge, the most detailed social assessment yet accomplished of the use of computer conferencing. It represents the Institute's final study of the FORUM/PLANET system and, in exploring the system's effects on research productivity, addresses a topic frequently raised. The project itself covered a two-year period, of which about 15 months were actually available for field testing. While it provides no easy

---

*See Murray Turoff, "Delphi Conferencing: Computer-Based Conferencing with Anonymity," *Technological Forecasting and Social Change*, no. 2, 1972; see also "'Partyline' and 'Discussion' Computerized Conferencing Systems," *Proceedings of the International Conference on Computer Communications*, Washington, DC, 1972.

**More detailed references to this work and findings to date can be found in Robert Johansen, Jacques Vallee, and Kathleen Spangler, *Electronic Meetings*, Reading, MA: Addison-Wesley Publishing Co., 1978; or Robert Johansen, "Social Evaluation of Teleconferencing," *Telecommunications Policy*, vol. 1, no. 5, December 1977, pp. 395-419. Basic direct references are provided in the bibliography of this report.

***This new system is called the Electronic Information Exchange System (EIES). A general description of the system is contained in Murray Turoff and Roxanne Hiltz, "Meeting Through Your Computer," *IEEE Spectrum*, May 1977, pp. 58-64.

answers to the complicated questions surrounding research productivity, it does offer insight into the measurable and potential effects of introducing computer conferencing into research environments such as those involved in this study.

I. COMMUNICATIONS AND RESEARCH PRODUCTIVITY: FOCUS ON WORKING PATTERNS

This chapter begins with a summary of the relevant literature on research productivity, develops an approach to measurement of research productivity based on the "proxy" of working patterns, and explains our general approach to this project.* While the literature on research productivity provided only limited guidance, a review of this material was part of the first phase of our project and did have a direct influence on the research design which was eventually followed. Our search was for literature which identified variables related to both communications and research productivity. An obvious beginning was to develop some viable approach to the elusive concept of "productivity."

DEFINITIONS OF RESEARCH PRODUCTIVITY

Studies of productivity in scientific research have typically used measures of success which are closely associated with academia. Judges have been asked, for instance, to evaluate individual scientists according to their "contribution to general technical or scientific knowledge in the field" and their "overall usefulness in helping the organization carry out its responsibilities" (Pelz and Andrews, 1966). The extent to which a scientist has "increased knowledge in his field through lines of research which were useful and new" has also been examined (Andrews and Farris, 1972). Data have been collected on patents and patent applications, published papers, and books, as well as unpublished technical manuscripts, reports, and formal talks (Pelz and Andrews, 1966).

---

*This chapter includes revisions of a paper completed early in this project, immediately after the literature review phase. See Robert Johansen and Jacques Vallee, *Impact of a Computer-Based Communications Network on the Working Patterns of Researchers*, Institute for the Future, Paper P-46, presented at the American Sociological Association Annual Meeting, 1976.

Moving away from purely academic standards, Lawler, Hall, and Oldham (1974) have defined overall performance by a composite of such factors as "net change in research and development budget during the last year" and "percentage of projects meeting time schedule."*

Unfortunately such measures of productivity, while clearly multidimensional, are not necessarily comprehensive, and there is no unifying framework within which the findings of these various approaches can be reconciled. In the extreme, "efficiency expert" approaches which seek to quantify all aspects of scientific productivity are vulnerable to what Alfred North Whitehead called the "Fallacy of Misplaced Concreteness."** Furthermore, any attempt to understand the impact of a new communications medium must compare performance measures for alternative organizational and communications characteristics. Such direct comparisons are indeed rare.

LABORATORY EXPERIMENTS WITH SMALL GROUPS

A logical beginning point in a search for information relevant to the problem of communications media and productivity is the literature of small group research. Overview books on group productivity and performance are now available, and Davis (1969) and Steiner (1972) are particularly good introductions. However, these general sources quickly dispel any hope for a well-organized literature base from which to draw. As Steiner says, "Present knowledge concerning group process and productivity is uneven and

---

*Edward E. Lawler, Douglas T. Hall, and Greg R. Oldham, "Organizational Climate: Relationship to Organizational Structure, Process, and Performance," *Organizational Behavior and Human Performance*, vol. 11, no. 1, 1974, p. 146.

**Alfred North Whitehead, *Science and the Modern World*, New York: Free Press, 1925. Illustrative of this point is an editorial published in *Archives of Pathology* (vol. 93, April 1972) which suggests a formula for a research productivity index given as:

$$RPI = \frac{A}{F + S + P}$$

where A is the number of articles published by a group, F is the research funds expended, S is the total space allocated to research, and P is the total personnel.

poorly integrated. We know a good deal about people's reactions to specific social situations, but know much less about the mechanisms by which two or more people react to one another to produce long sequences of collective action."* The problem in deriving useful information from this literature, then, is organizing and applying the results from widely varied studies. Particularly important is the identification of variables related to productivity in groups comparable to those doing scientific research.

Small group research on productivity has typically been experimental. Subjects are given assignments under varying, but controlled, conditions; and their performance is then assessed. These assignments, usually in the form of a "problem" to be solved, are important to the interpretation of the results. Zagona, Willis, and MacKinnon (1966) reviewed the various assigned tasks used in creative problem-solving experiments and concluded that task is a critical variable. Those experimental tasks reviewed varied considerably and were often questionable in terms of their relevance to nonlaboratory situations. Attempting to examine task performance in a less artificial environment, Pye, Champness, Collins, and Connell (1973) have developed a categorization system called "Description and Classification of Meetings" (DACOM), derived from actual meetings occurring among civil servants and businesspeople in Great Britain. The relationship between the DACOM categories and those used in experiments, however, is not clear. Furthermore, the DACOM categories are sometimes difficult to transfer from one social context to another. In summary, research to date indicates that "task" is an important variable in group productivity. Some effort has been made to categorize types of tasks, but the relationships between task type and performance are clearly complicated by other variables.

Group characteristics are shown to be important in a number of research efforts, but the results are far from consistent. Lorge, Fox, Davitz, and Brenner (1958) have surveyed experiments on individual and group performance from 1920 to 1957. On size of group, they conclude tentatively that "greater

*Ivan D. Steiner, *Group Processes and Productivity*, New York: Academic Press, 1972, p. 12.

production on 'abstract' problems can be expected from smaller groups than from larger groups, and greater production on 'concrete' problems from larger groups than from smaller ones."* Raven (1965) discusses size of group as one factor related to group performance and concludes by quoting Fink's (1963) finding that "under no conditions were smaller groups superior" in quality of performance and group productivity, but that speed of completion of tasks was not so clearly related to group size.** As was emphasized by Lorge et al., however, these generalizations are based upon a limited amount of research and must be treated cautiously.

Other group characteristics, such as cohesiveness and morale, also appear to be important to group productivity. Shaw (1971) states that "Group members who are attracted to the group work harder to achieve the goals of the group; one consequence of this is higher productivity by more cohesive groups."*** Moos and Speisman (1962) have also examined the relationship of "group compatibility" to productivity and concluded that it is indeed an important factor. While such findings might seem obvious, they are nevertheless called into question by Stogdill (1972), who concludes that cohesiveness and group productivity are only conditionally related and that intervening variables must be considered. In particular, he argues that "group drive or motivation is the variable most consistently related to productivity."****

Studies of communications networks within small groups appear to be closely related to the research task at hand. The classic studies by Bavelas (1950) and Leavitt (1951) form a good beginning point. Their studies involve varied structures for communication channels within groups,

---

*Irving Lorge, David Fox, Joel Davitz, and Marlin Brenner, "A Survey of Studies Contrasting the Quality of Group Performance and Individual Performance, 1920-1957," *Psychological Bulletin*, vol. 55, 1958, pp. 359-60.

**Bertram H. Raven, *Group Performance*, University of California, Los Angeles, February 1, 1965, p. 3.

***Marvin E. Shaw, *Group Dynamics, The Psychology of Small Group Behavior*, New York: McGraw-Hill, Inc., 1971, pp. 200-1.

****Ralph M. Stogdill, "Group Productivity, Drive, and Cohesiveness," *Organizational Behavior and Human Performance*, vol. 8, 1972, p. 39.

with a focus on the virtues of the different structures in producing high speed and quality measures. Centralized networks generally produced faster, though sometimes less "creative," results (Leavitt, 1951). Later replications with complex problems, however, showed the opposite results, with the decentralized pattern being more effective (Shaw, 1964). More recent investigations suggest that intervening variables involving decision-making processes and leadership may be more important than the structure of the communication channels (Guetzkow and Simon, 1955). Thus, the structure of communication networks has a demonstrated importance, but, like other variables, can easily be blurred by intervening factors.

Zagona et al. (1966) have perhaps gone as far as anyone in trying to draw practical conclusions from small group research related to productivity. Based on their survey, they offer the following description of an ideal group structure for creative problem solving:

> It should be nonhomogeneous in terms of member personalities and in terms of attitudes, cohesive in terms of sociometric choices, and possibly should also be capable of producing some conflict between subordinate members and a member in an authority position. The group should be open and, if the group is working under stressful conditions, the leader should be firm; but if the group is working under pleasant and relaxed conditions, the leader should be permissive and nondirective.*

Clearly, every variable mentioned in the literature of small group research on productivity is open to debate. This summary does, however, provide clues about important characteristics to observe in searching for relationships between research productivity and the introduction of a new communications medium.

There is also a recurrent question of the relevance of laboratory experiments in drawing conclusions related to what goes on in real-world settings, such as energy research environments. Laboratory experiments typically involve paid subjects--usually students--performing artificially designed tasks. The subjects have often not met each other before the

---

*S. V. Zagona et al., "Group Effectiveness in Creative Problem Solving Tasks: An Examination of Relevant Variables," *Journal of Psychology*, vol. 62, 1966, p. 134.

experiment begins. One can legitimately question how much laboratory experiments have to say about the conduct of a field test such as that in the current study.* Thus, field studies which go directly into research environments seem a more promising source of guidance about variables related to both communications and research productivity.

FIELD STUDIES OF RESEARCH PRODUCTIVITY

Numerous studies have examined scientific research environments directly, often considering the problem of research productivity. Several major books have been written (Taylor and Barron, 1963; Pelz and Andrews, 1966; Allison, 1969; Nelson and Pollock, 1970), each of which raises general questions about the nature of scientific productivity. Also, such organizations as the National Academy of Sciences (1969) and the American Psychological Association (1966) have sponsored major studies on scientific communication.

The Pelz and Andrews effort is probably the most widely acclaimed and comprehensive to date. They studied 1,300 scientists and engineers in 11 research and development laboratories, with responsibilities which ranged from basic research to product development. The performance of individual scientists is assessed by various judging procedures using peers and supervisors, as well as by numbers of professional papers or patents. These multiple performance measures are then correlated with various characteristics of the research environments in an attempt to discover conditions which seem to influence research productivity.

Of particular interest for our own study are the environmental characteristics related to communication. The general finding is that "those who had relatively frequent contact with colleagues tended to perform at higher

---

*Some of the specific problems of using laboratory experiments in the social evaluation of new communications media are discussed in Robert Johansen, "Pitfalls in the Social Evaluation of Teleconferencing Media," in Lorne A. Parker and Betsy Riccomini, eds., *The Status of the Telephone in Education*, Madison: University of Wisconsin-Extension Press, 1976, pp. 122-7.

levels than those with less frequent contact."* Frank Andrews further analyzes the data, concluding that the findings "tended to support the hypothesis that contact with colleagues could stimulate performance. Furthermore, they suggested that this was more likely to happen if the contacts were purposefully originated by people directly concerned--the man himself or his colleagues--than if they were unplanned or originated by some third party."** Pelz and Andrews are also unable to find evidence of scientists for whom colleague contact was not useful in some measurable way. In a follow-up study six years after the original study, Farris (1969) offers further support for the notion that communications contacts can stimulate scientific performance and vice versa.

The work of Thomas Allen (1970) and his colleagues adds depth to the analysis of scientific communication by introducing the notion of communication roles, particularly that of the "gatekeeper": "The technological gatekeeper receives information from a wide variety of sources external to his organization and acts as an information source for his colleagues in his group."*** Also, Allen's work has found that there is a direct relationship between perceived accessibility of information channels and utilization of those channels. Furthermore, those channels perceived to be highest in technical quality are not necessarily those most frequently used; apparently cost balances value, and accessibility is the most important determinant of choice among channels (Gerstberger and Allen, 1968).

---

*Donald C. Pelz and Frank M. Andrews, *Scientists in Organizations: Productive Climate for Research and Development*; New York: John Wiley and Sons, Inc., 1966, p. 36 (revised edition: Ann Arbor, MI: Institute for Social Research, 1976).

**Frank M. Andrews, "Contacts with Colleagues and Scientific Performance," *Discovery*, October 1966, p. 14.

***Thomas J. Allen, James M. Piemeier, and S. Cooney, "The International Technological Gatekeeper," *Technology Review*, vol. 73, no. 5, March 1971, p. 36.

These findings suggest that the communication patterns among researchers--both within and among organizations--are an important factor in scientific productivity.*

Lawler, Hall, and Oldham (1974) have applied the notion of "organizational climate" to assess the importance of an employee's subjective impressions of his own organization. They argue that climate is a variable which is related to organizational characteristics and has a profound influence on productivity. Observing a group of 117 directors of research laboratories in the State of Connecticut and a sample of 291 scientists at 21 of those laboratories, they have concluded that the effects of climate seem more direct than those of the more basic organizational and structural variables. McCarrey and Edwards (1973), in a study of 72 biological scientists in Canada, affirm the importance of climate variables, while pointing out that "there does not appear [to be] a magical package of climate perceptions that unequivocally bind organizational system variables to individual role performance."**

Research environments also involve a significant degree of management activity, much of which is often performed by the researchers themselves. In a field such as energy research, the researcher cannot always withdraw and think; he or she must engage in managerial functions as well. Studies of managerial activities, however, reveal only partial understandings of what a manager actually does. Mintzberg (1971) characterizes the manager's role as concentrating on "issues that are current, specific, and ad hoc,"***

---

*Research on "invisible colleges" is indirectly relevant here, since it has attempted to track the effects of informal professional communication among colleagues. Using such techniques as surveys (Crane, 1969) and citations (Parker, Paisley, and Garrett, 1967), these studies demonstrate both the importance of information communication ties in scientific communities and the difficulty of measuring these patterns through conventional communications media typically used (e.g., letters, hallway meetings at conventions, telephone calls).

**Michael W. McCarrey and Shirley A. Edwards, "Organizational Climate Conditions for Effective Research Scientist Role Performance," *Organizational Behavior and Human Performance*, vol. 9, 1973, p. 455.

***Henry Mintzberg, "Managerial Work: Analysis from Observation," *Management Science*, vol. 18, no. 2, October 1971, p. B100.

In this and his later work,* Mintzberg emphasizes that the manager's job involves a great deal of communications activity. He points out that "where possible, he [the manager] appears to gravitate to verbal media since these provide greater flexibility, require less effort, and bring faster response."** The communications media used, however, must be compatible with the time demands of the job. The mails are used primarily to respond, rather than to initiate communication.

The single research effort which perhaps most closely parallels the problem at hand involves a field experiment in altering the office layout of a product engineering department in an attempt to see if the new architectural design would have a measurable effect on performance (Allen and Gerstberger, 1973). In this case, office partitions were removed to create a large common work space. When a new communications medium such as computer conferencing is introduced into a research environment, there is the potential for a similar alteration of the intellectual "architecture" as a result of new communication opportunities. Allen and Gerstberger have found strong evidence that the new office structure "worked" in the sense that it was well received and used by the test group. However, there was no measurable increase in departmental performance. Such a finding may be somewhat unsatisfying, but it indicates the problems in obtaining measurable effects on research productivity resulting from the introduction of a new communications medium, even when test groups report satisfaction with it.

---

*See Henry Mintzberg, *The Nature of Managerial Work*, New York: Harper & Row, 1973; and Henry Mintzberg, "The Manager's Job: Folklore and Fact," *Harvard Business Review*, July-August 1975. Compatible approaches, stressing participant observation methods, are also being pursued to assess the potential impact of office automation. See James H. Carlisle, "Evaluating the Impact of Office Automation on Top Management Communication," *Proceedings of the National Computer Conference*, 1976, pp. 611-6.

**Henry Mintzberg, op. cit., p. B-101.

DRAWING CONCLUSIONS FROM PREVIOUS RESEARCH: FOCUS ON WORKING PATTERNS

While sometimes seductive, the research findings noted above are far from conclusive, and they fail to provide a firm basis for structuring an assessment of computer conferencing. They do, however, provide a source of "working pattern" variables which may be related to scientific productivity. These include such basic factors as when people work, where they work, how they work, with whom they work, and on what they work. It seems clear that such fundamental configurations of work activities must have *some* relationship to research productivity. At the same time, they are likely to be sensitive to alterations in the communications resources available to a given group. They thus appear to be the most viable linkage between media effects and scientific productivity.

This linkage provides a means of exploring the effects of computer conferencing on research productivity without becoming bogged down in direct and sometimes problematic output measures. While many approaches to productivity assessment have relied on "end product" measures, the present study has focused instead on the *process* of communication in a research environment. We ask: "What effects does (and could) computer conferencing have on working patterns?" and then allow potential users to judge whether those particular working pattern variables are relevant to productivity in their own environment. Such an approach, however, rules out any simple jumps from data-gathering to purely mathematical or statistical statements about the effects of computer conferencing on research productivity. Given the state of research on productivity as summarized above, such a qualification in approach seems entirely appropriate.

The productivity literature cited here was the major source of information about working patterns potentially related to both communications and research productivity (see Table 1). Originally, we had hoped to do

TABLE 1. SUMMARY OF VARIABLES PREVIOUSLY ASSOCIATED WITH COMMUNICATIONS AND GROUP PRODUCTIVITY

- Types of scientists by professional experience (Pelz & Andrews, 1966)
- Availability within group of requisite abilities or skills (Darley et al., 1952)
- Leadership which is both accepted and persistent (McCarrey & Edwards, 1973; Darley et al., 1952)
- Physical proximity (Gerstenfeld, 1970)
- Extent of contact with colleagues (Farris, 1969)
- Frequency of contact with colleagues (Allen, 1972; Crane, 1970; Andrews, 1966)
- Number of people with whom contact is maintained (Andrews, 1966)
- Acceptability of information source (Gerstberger & Allen, 1968)
- Compatibility of group members (Pelz & Andrews, 1966; Moos & Speisman, 1962)
- Acceptance of group goal (Darley et al., 1952)
- Group cohesiveness (Schachter et al., 1951; Darley et al., 1952; Zagona et al., 1966; Shaw, 1971; Stogdill, 1972)
- Distance between each group (Allen, 1970)
- Similarity of people with whom contact is maintained (Pelz, 1956)
- Skill in written communication (McCarrey & Edwards, 1973)
- Team heterogeneity (Smith, 1971)
- Number of colleagues in own group (Zagona et al., 1966; Andrews, 1966)
- Excess time pressure (Andrews & Farris, 1972)
- Support for collaborative efforts (Lawler et al., 1974)
- Generality/specificity of research assignments (Lawler et al., 1974)
- Professional autonomy (Lawler et al., 1970, 1974)
- "Organizational Climate" test instrument (Lawler et al., 1974; McCarrey & Edwards, 1973)
- Communication "bonds" and "barriers" (Morton, 1969)
- Percentage of time spent on research task (Pelz, 1970)
- Accessibility of information (Gerstberger & Allen, 1968)
- Threat reduction (Gibb, 1951)
- Constraints on group (Zagona et al., 1966)
- Flexibility of work structure (McCarrey & Edwards, 1973)
- Involvement in planning (McCarrey & Edwards, 1973)
- Management contact (McCarrey & Edwards, 1973)
- Time used in maintaining colleague contacts (Andrews, 1966)
- Informal person-to-person communication (Menzel, 1966)
- Extent of group participation (Darley et al., 1952)
- Frequency of contact with dissimilar colleagues (Pelz, 1956)
- Length of workday (Andrews & Farris, 1972)
- Self-activation of communications channel (Andrews, 1966)
- International communication (Allen et al., 1971)
- Diversity of work activities (Farris, 1969)
- Types of tasks or problems (Pye et al., 1973; Zagona et al., 1966)
- Communication patterns (Bavelas, 1950; Leavitt, 1951)
- Group participation (Darley et al., 1952)
- Speed of task accomplishment (Lyle, 1961)
- Use of differential skills of group members (Darley et al., 1952)

open-ended interviews with the field test participants before they began using computer conferencing to gather their views about those working patterns *they* felt were most related to their own productivity. For reasons which will be more clear in Chapters II and IV, these initial interviews were not possible. Group selection was more difficult than had been anticipated, and there was no incentive for potential participants to engage in candid discussions about their own productivity. Furthermore, such discussions could have identified the study team with "outside evaluators" in participants' minds and discouraged their participation in the field tests. Thus, we were forced to rely on the literature and our own judgment about which working pattern variables might be most related to both the use of computer conferencing and measurement of research productivity.

RESEARCH APPROACH: MULTIPLE MEASURES OF WORKING PATTERN EFFECTS

Given this orientation toward working patterns, our basic goal in the research design was to place the participants in the best possible position to make critical judgments about the real and potential effects (both positive and negative) of computer conferencing. Since persons such as those in the test groups will eventually make--and to some extent already are making--real decisions about whether or not this new medium is adopted, such an approach is easily justified.

This type of project requires a variation from the traditional strong separation between "evaluator" and "subject." Instead, we attempted to develop a working relationship with the field test participants such that we had some understanding of their daily work environment and we--as evaluators--were seen in a collegial rather than judgmental light.* (If we

*See Barnes (1967), Seashore (1964), and Campbell (1969) for varied perspectives on the operational problems of taking this approach to evaluation.

had been viewed as evaluating their personal or group performance, we certainly would not have been allowed to continue the study.) Three characteristics summarize the overall research design:

1. The assessment took place in the field, with scientists involved in their normal activities. The goal was to place them in a situation where they would be competent evaluators of computer conferencing and its effects.
2. Scientific "productivity" was not assessed directly but by measuring effects on working patterns with likely relationships to research productivity. The emphasis was on *process* rather than *outcome* measures.
3. Multiple measurement approaches were used to gather information about real and potential effects on working patterns.

We began the project with the goal of conducting a study of energy research groups using computer conferencing over time. Realizing that laboratory-like control was not possible in a field environment such as this, we opted for what Campbell and Stanley have dubbed a "patched-up" research design. Noting some of the problems with this approach--which combines elements of experimental, quasi-experimental, and field test designs--they point out that "the result is often an inelegant accumulation of precautionary checks, which lacks the intrinsic symmetry of the 'true' experimental designs but nonetheless approaches experimentation."*

In assembling our "patched-up" design, we aimed toward as much control as might be possible in the complex energy research environment. Using the time series approach, we identified key variables and tracked them throughout the field test period. Furthermore, we sought an "on-again, off-again" scheduling, where groups would alternate their use of computer conferencing with more conventional communications media. In designing the study, we knew that if sufficient control were achieved, the result would be a quasi-experiment; if not, it would be a very well-organized field test.

*Donald T. Campbell and Julian C. Stanley, *Experimental and Quasi-Experimental Designs for Research*, Chicago: Rand McNally & Co., 1963, p. 57.

Unfortunately, the latter description best fits our end product. The major problems involved group selection and scheduling such that the groups approached an "on-again, off-again" usage pattern. (Group selection will be discussed in greater detail in Chapter II.) Ideally, we sought what Cook and Campbell called an "interrupted time series with switching replications."* This design calls for different groups to use computer conferencing at different times, so that each group is using the new medium while another is using conventional media. The groups would then "switch" media, with each serving as a comparison group for the other.

In practice, it was very difficult to arrange for groups to use computer conferencing for only defined periods of time--especially if the defined periods were to be in sequence with the usage of other groups. If groups began using the new medium, they either continued through the life of the project (and beyond in several cases) or they stopped completely. There was no incentive for real groups to conform to the pattern of usage called for by our preferred research design. Also, there was a real reluctance to participate in pretests before the usage period began. Questionnaires sometimes had the effect of "scaring away" potential participants and less obtrusive methods (e.g., observation of communication patterns) were either very difficult to arrange or would have been perceived as a violation of group privacy. Thus, the interruptions in the time series were not achieved, making comparison across groups very difficult.**

One key decision was made early in the project: that groups would not have free access to computer conferencing. Our judgment was that computer conferencing, if it is introduced on a broader scale, will not be free. (It probably will not even be inexpensive.) And the judgments of participants as to whether or not to adopt the new medium will certainly have to deal with cost factors at some point. Thus, in order to provide a realistic backdrop concerning costs, the field test groups were required to pay

*Thomas D. Cook and Donald T. Campbell, "The Design and Conduct of Quasi-Experiments and True Experiments in Field Settings," in M. D. Dunnette, ed., *Handbook of Industrial and Organizational Research*, New York: Rand McNally, 1976, pp. 223-326.

**See Appendix A for policy implications of our research design.

the cost of computer time on the commercial network being used for the field tests. (Most of the groups arranged for a single source of funding for usage by all participants; one group billed individuals separately for their usage.) The costs averaged between $12 and $25 per terminal hour, even though no royalty or usage charges were made. These cost figures may be somewhat high based on current forecasts for the 1980s, but we felt they were reasonable for these tests. Typically, demonstration conferences were given to candidate groups; when their actual usage began, it was their own responsibility to absorb computer time costs. During this study, we did not do detailed analyses of costs, although some relevant policy issues are raised in Chapter V.

Usage periods of up to 15 months were documented for 14 groups. Each group thus had considerable experience with computer conferencing, often mixed with other more conventional media such as face-to-face meetings, telephone calls, or mail. Unfortunately, the research design focused only on those groups who actually used computer conferencing. While we attempted to gather reactions from those who tried the medium but then stopped, most of our information comes from persons who actually used computer conferencing during the project. Their experience was tracked using three measurement techniques: usage statistics, questionnaires and interviews, and limited field observations of both face-to-face and computer conferences.

Usage Statistics: During computer conference sessions, usage statistics--some of which are related to working patterns--can be gathered automatically by the conferencing program without violating the substantive privacy of the proceedings. Such variables as time of participation, numbers of sessions, numbers of messages, use of system commands, and patterns of message exchange can all be recorded unobtrusively.* Appendix F summarizes

*While the substantive privacy of the proceedings is not violated by collecting usage statistics, the potential misuse of this data clearly implies a policy issue. In the current project, participants were told that usage statistics were being gathered as part of the Institute's teleconferencing research program. Computer conferencing was not offered as a public service. If and when such a service is offered or computer conferencing becomes routinely accepted within particular organizations, it will be very important to have explicit guidelines as to how--if at all--usage statistics should be kept and used. In fact, many usage statistics are already kept by commercial computer companies.

all the usage statistics gathered; these variables can be examined according to conference groups or individual participants.

Usage statistics provide the basis for a sort of automatic sociogram on the usage of each group. Also, month-by-month (or even week-by-week or day-by-day) usage could be documented over the time series period for this study, for both groups and individuals. While usage statistics provide only limited information, they do offer a terse baseline of data which can be enriched by information gathered from other sources.

Questionnaires and Interviews: Questionnaires and interviews were used to gather participants' perceptions about effects of computer conferencing on their working patterns. To document the goals of the groups, something of their history, and their expectations for the use of computer conferencing, initial interviews were held with at least one person--usually the leader--from each group. (See Appendix B for the initial interview schedule.)

Questionnaires were mailed at three-month intervals throughout the project to gather information about participants' existing working patterns and their reactions to experiences with computer conferencing. With groups which would agree, pretest questionnaires were used before usage of computer conferencing began. The questionnaires were very brief (see Appendix C for a copy) and designed so that they could refer to usage of either computer conferencing or other media. One additional question was added for post-computer conference versions. The next-to-the-last questionnaire was not distributed as response rates to earlier ones had fallen and negative reactions to the burden of filling out even brief questionnaires increased. In most cases, however, at least three rounds of questionnaires were obtained for each group.

The questionnaires not only sought general reactions to the users' experience with computer conferencing, but also asked a series of questions about their working patterns over the previous three-month period. Table 2 presents the working pattern variables treated in the questionnaire. These variables, suggested primarily by our literature review (see Table 1), are those likely to be associated with both communications and research productivity. With at least three questionnaires for each group, changes in

TABLE 2. WORK PATTERN VARIABLES RELATED TO COMMUNICATION

How frequently do you do each of the following:

- Communicate with researchers in your own organization (work related)
- Communicate with researchers in other organizations in your locality
- Communicate with researchers in different regions of the United States
- Communicate with researchers in other countries
- Communicate with researchers in other disciplines
- Work at home
- Work outside of normal office hours
- Read work-related articles and books
- Exchange letters with other researchers
- Use the telephone to talk with other researchers
- Travel for discussions with other researchers
- Use method *other than* letters, telephone, or travel for communicating with other researchers

Respondents are given a 7-point scale from "daily" to "less than once every three months."

responses to these questions were a major source of information about working pattern changes during the project. Chapter III contains the results of the questionnaire responses; Appendix F describes the analysis techniques which were used.

Finally, interviews were done with key participants toward the end of their usage period. These nondirective interviews, lasting several hours each, were designed to fill in some of the "context" missed by the usage statistics and the questionnaires. They were conducted using a set of basic questions (see Appendix B). In many cases, however, a more focused approach was employed to follow up on issues raised by the questionnaires or usage statistics. The interviews thus served as a flexible means to fill in "holes" left by the other measurement techniques.

Field Observations: In most cases, Institute staff was allowed to be participant-observers in the computer conferences. Typically we were silent participants, answering only occasional questions about the computer conferencing system itself. In this way, however, we were able to gain a sense of the groups' activities at various stages. Notes from these experiences, as well as the questionnaires and interview schedules, were kept in files for each participant and each group. Also, a large wall display was used to track each group's activities. The informal information gathered in this way was very useful in understanding the context of each group, as well as the specific manner in which they were making use of the medium.

Observations of face-to-face meetings of these groups were difficult to arrange but did prove useful on several occasions. In particular, we compared substantive orientation and group dynamics in face-to-face meetings with those in the computer conferences. Again, the goal was to better understand the context in which computer conferencing was being used.

Finally, transcripts of most of the computer conferences were obtained and, to some extent, content analyzed. While we saw no great value in word-counting the transcripts, we did find it useful to identify predominant themes. Such an approach was particularly useful in understanding high- and low-usage periods indicated by the usage statistics. Also, specific

comments about computer conferencing or its potential effects on working patterns were extracted.

Using the measurement approaches described above, we sought to examine the use of computer conferencing from as many different perspectives as possible and document participants' reactions in some detail periodically throughout the usage period. The results may be, as Campbell and Stanley have suggested, "patched-up" and somewhat "inelegant." The concept of research productivity is complex, however, as is the environment in which our test groups operate. Therefore, flexibility was a critical component in both the design and implementation of the study.

II. GROUPS AND INDIVIDUALS: A CASE STUDY OF USAGE STYLES

Computer conferencing cannot be assessed in the abstract, apart from the varied ways in which people use it. The characteristics of computer conferencing are only part of a mix of factors; one must also examine the characteristics of the individuals and groups who are using it and the tasks which are being performed. The "styles" of computer conferencing usage are likely to move through phases as the needs of the user group change. These styles are not predestined by the technology nor predictable by the technologists. The exploration of the ways in which computer conferencing might be used is only just beginning.

In this chapter, we will describe both the group and the individual styles of computer conferencing we have observed during this project. In so doing, we are not suggesting that these are the *only* possible styles. Rather, we are simply describing those styles observed so far as a referent for analyzing the working pattern effects to be explored in Chapter III.

The participants in this study were primarily involved in the general area of "energy research," a field which is rather loosely defined. The original project design called for test groups from the Energy Research and Development Administration (ERDA) and the Electric Power Research Institute (EPRI). Initial discussions were held with both organizations and enthusiastic letters of support included with our proposal to the National Science Foundation for this project. However, the actual practice of selecting the participant groups proved more difficult than we had initially anticipated. Since we were committed to the notion of a realistic field test in which users would be paying at least a portion of the costs, the selection was made even more difficult. The approach we followed was to identify key persons within each organization who had a high need to work with remotely located persons (e.g., at the various ERDA laboratories). We held a number of seminars at the various locations and made 50 to 75

inquiries by letter or telephone in early- to mid-1976. The approaching Presidential election proved to be a significant factor we did not anticipate. Many important decisions about interlaboratory communication were delayed until after the election. Also, we learned that several organizations had no budget category compatible with computer conferencing, since it is a hybrid of computing and communications (two separate budget items).

Computer conferencing is still a foreign concept to most people, even those familiar with computers. Since we were seeking groups which would use the medium over an extended period of time, this sort of commitment was not obtained casually. It took a certain degree of "selling," if only on the virtues of *trying* the medium. The tension for the Institute team was balancing our desire for appropriate field test groups with the possibility of creating a "Hawthorne Effect" (influencing the results of the study in unintended ways).

One of our initial hopes was that we would learn something from those groups who did *not* want to participate in the study, or who started but then stopped. The design of our project, however, made it much easier to gather information from those who made at least some use of computer conferencing. Those who did not had little incentive for responding to our questionnaires. And our research design did not include more aggressive information-gathering techniques oriented toward nonusers. It seemed that a major factor relating to whether or not a group participated in the field test was related to organizational inertia—especially with regard to a new and unknown communications medium. The groups which did participate overcame this inertia for various reasons, the most frequent of which was a strong leader who became an advocate of the field test. These factors relating to receptivity toward computer conferencing will be explored in more detail in Chapter IV. At this point, it is most important to understand the characteristics of the groups and individuals who *were* involved in the study.

Overall, there were 13 separate groups who participated in the field test (see Table 3), as well as several others who used the medium for only brief periods. Approximately 250 participants used the medium at some point during the study (see box, page 30, for participant characteristics). Groups typically

TABLE 3. GROUPS PARTICIPATING IN THE WORKING PATTERNS STUDY

Group Name	Active Dates	Total Number of Participants
Kettering: Colorado Plateau Research Project (CPRP)	June 1976-August 1976	9
Kettering: Food/Climate	April 1976-June 1976	11
ERDA: Interlaboratory Working Group for Data Exchange (IWGDE)	September 1976-July 1977*	31
ERDA: Network Investigators	June 1976-July 1977*	30
ERDA: Network Objectives	July 1976-July 1977*	17
ERDA: Berkeley Data Management	July 1976-July 1977*	20
ERDA: National Coal Assessment:		
Health Effects	October 1976-March 1977	6
Water Effects	October 1976-March 1977	13
ERDA: County-Level Data	March 1977	40
USGS: Earthquake Prediction	July 1976-July 1977*	10
USGS: GRASP	December 1975-July 1977*	12
USGS: Remote Office	September 1976-July 1977*	6
NASA: Communications Technology Satellite (CTS) Experimenters	October 1975-July 1977*	32

*Data collection ended July 31, 1977.

involved 5 to 20 active participants, although as many as 40 were listed as participants in some cases. The organizations represented included ERDA, United States Geological Survey (USGS), the Charles F. Kettering Foundation, and the National Aeronautics and Space Administration (NASA). The NASA group was probably the least related to the area of "energy research," but does provide a useful comparison group, as will be clear in the following analysis of usage styles.*

CHARACTERISTICS OF THE FIELD TEST PARTICIPANTS

The typical participant in this study could be characterized as a white male in his late 30s or early 40s, working at a major research laboratory or university in the suburbs of a major U.S. city. (Less than 10 percent of the study participants were women.) Most were scientists with at least some graduate training and were typically involved in some aspect of energy research. Considerable computer experience was common. Also, many of the participants had at least some management responsibilities.

GROUP CONFERENCING STYLES

Volume 3 of this series was based on two years of computer conferences held over the computer network of the Advanced Research Projects Agency (ARPA) in the U.S. Defense Department. In it the Institute identified five

*These field tests focused on small group communication as it occurred within (and between) a number of organizations. We had little access to information about the organizational dynamics surrounding the operations of these groups, and the absence of this type of information is a major limitation of our study.

basic styles of computer conference usage. The current study provides the opportunity to revise these styles on the basis of considerably more usage data. For the sake of comparison, we will begin with the original definitions used in the 1975 report, following them with revisions suggested by the current study. The five styles originally identified were "the notepad," "the seminar," "the assembly," "the encounter," and "the questionnaire."

The style first identified as "the notepad":

> . . . typically involves unstructured groups and a discussion with multiple topics lasting several weeks or even months. It is almost entirely asynchronous, with little interpersonal interaction. The simplest example of this conferencing style is the "notepad" activity of scientific research groups.*

This definition now seems a little inaccurate. Notepad conferences can occur in groups having varied degrees of structure, and they are rarely shorter than one month in duration. There is typically no prespecified termination date for the activity. Also, there now appear to be two distinct styles within the category we previously labeled "notepad." Therefore, we suggest eliminating the rather broad notion of the notepad and introducing two new designations which we call "exchange" and "community."

Exchange

This style of usage is typically carried out over a period of months. The participating groups are usually quite large, ranging in size from 20 to 35 or 40. (Even larger groups would be possible, though the upper limit is not clear.) Participants have a high perceived need to stay in touch with each other, either by directive from their superiors or from their own motivation. The function of the "exchange" remains rather constant, and the amount of social interaction is typically quite low. Thus, the number of messages per given time period would typically be low, as would the number of private messages** exchanged. There is generally more

---

*Jacques Vallee; Robert Johansen; Hubert Lipinski; Kathleen Spangler; Thaddeus Wilson; and Andrew Hardy, Consultant; *Group Communication Through Computers, Volume 3: Pragmatics and Dynamics;* Institute for the Future; Report R-35; October 1975; p. 15.

**Off-the-record messages directed to a single party and not saved by the system.

commitment to the topic of conversation than to the other participants.

A clear example of the "exchange" usage is that of the NASA Communications Technology Satellite (CTS) principal investigators. This is a technically oriented group of persons from various organizations, all experimenting with the CTS Satellite launched jointly by the U.S. and Canadian governments. NASA staff has the critical task of coordinating the activities of all the experimenters and quickly sending information about changes in the status of the satellite.* Over a usage period of nearly two years, 20 participants checked into PLANET at least once every two workdays on the average; 10 of those averaged once every workday.**

The substance of the communication typically involved the details of satellite operations and scheduling. The language was terse, and participants developed their own shorthand designations, some of which had origins in short-wave radio terminology. (E.g., "UR" was used for your, "PLS" for please, "10Q" for thank you, "MSG" for message. It should be noted that these shorthand messages sometimes served a social function as well, by adding a note of informality or humor, as with the following: "PLS SEND ME HIS NAME RANK AND HORSEPOWER ASAP.") The leader of the conference made the ground rule that no informal discussion would be held via public messages; private messages were to be used for this purpose. Although we had no access to the substance of these private exchanges, participants told us in interviews and questionnaires that they were used for topics such as negotiating trades in scheduled satellite time or other topics which concerned a small subgroup.

The proceedings were intentionally oriented toward very functional and businesslike exchanges, and apparently the medium proved very effective

---

*The group has been using PLANET since late 1975. Thus, their usage began before any of the other field tests described in this report. Also, in October (23) of 1975, the director of the project at NASA required that *all* experimenters use PLANET regularly as the primary source of information exchange among the participants.

**Appendix E contains all the basic usage data for each group involved in this study. NASA CTS data is located on pages 160-1.

for this purpose.* Discussions of other subjects did occur, but they were quite rare. For instance, project managers at NASA used private messages and a separate conference (where others were not invited) to discuss management decisions. The group had very specific reasons for using PLANET and those reasons remained relatively constant. The leader was strong and set very specific guidelines for the type of communication which should occur.

Two other groups attempted "exchange"-style computer conferences but were not as clearly successful. One was the National Coal Assessment Health Effects Group and the other was a group of designers and users of the Berkeley Data Management System (BDMS), developed at Lawrence-Berkeley Laboratories. The Health Effects Group used PLANET for almost a year, but at rather low levels. (See Appendix E, p. 150.) Only five participants averaged one session per week or more and even this usage was erratic. While they were interested in the use of computer conferencing for continuous communication, they never made it over initial start-up problems.** Apparently, there was not a high enough perceived need to communicate among the participants, and there was no central authority which required participation.

By contrast, the BDMS group had a common experience base in that they were all designers or users of the same system. Their usage of PLANET averaged one session every two weeks, or less. Again, however, there was no consistent leader or leaders and no requirement for participation. Since participant use varied and there were other channels (e.g., the telephone) available for specific problems, the group never developed any real momentum during the field test period. A few months before the end

---

*An examination of the first year of PLANET usage at NASA (including other groups and before this project began) is contained in Jacques Vallee and Thaddeus Wilson, *Computer-Based Communication in Support of Scientific and Technical Work*, Institute for the Future, NASA Report No. CR 137879, March 1976. The analysis of this group in the present report will concentrate on their later usage and the effects on working patterns, neither of which was discussed in the earlier study.

**These start-up problems will be discussed more fully in Chapter IV of this report.

of our field test period, however, PLANET usage by the BDMS group increased substantially; and within three months after our field tests ended, they became a focal conference within the ERDA community.

For the "exchange" to work, the use of computer conferencing must become part of the normal work habits of most of the participants, and the tasks must be accepted as *group* tasks. This adaptation occurred in the case of the NASA group but not as easily in the case of the Health Effects or BDMS groups. The "exchange," like other styles, requires regular participation--whether it arises from a need felt by the participants or an order from above. While the specific topics of conversation will vary, there needs to be some common thread which ties the participants together. There may be varied leaders, but it seems to help if *someone* assumes the basic responsibility for keeping the group going.

Community

Computer conferencing can facilitate an electronically joined community of persons whose ties grow beyond topically-oriented exchanges of information. This "community" conferencing style implies a qualitative change from the "exchange" toward more cohesiveness as a group and a higher degree of interpersonal interaction. The individuals become committed to the other participants (at least to a limited degree) and to the purposes of the group. The topics may vary considerably, but they will involve more in-depth discussions and probably more personal involvement on the part of the participants. The groups also tend to be smaller than the "exchange" style, typically numbering less than 15 active participants.

While this style has not been fully demonstrated to date, several groups in this study developed most of the characteristics listed above. The Interlaboratory Working Group for Data Exchange (IWGDE), with members from each of the ERDA regional laboratories, was one such group. The participants typically worked with each other to develop computer resources needed for specific energy research problems. In some cases, discovering an available data base or model at another laboratory could save months of development time. Thus, the participants had a high incentive to exchange information and had already begun to do so before they began using PLANET. This high incentive to

participate was present, even though they had little direct financial support or requirement for their involvement in the activity. The great majority of participants averaged at least one session every three working days (see Appendix C, page 143) over a period of nearly a year. Both the cohesiveness of the group and the degree of social interaction are considerably higher than the "exchange"-style groups.

The IWGDE continued to have periodic face-to-face meetings: one was held during this project, and an informal meeting took place at a larger conference involving a number of the participants. The highest usage period for PLANET was immediately preceding a face-to-face meeting. No letters were exchanged during the planning period for the face-to-face meeting; all arrangements were made through the system. The face-to-face meetings provided an informal meeting place and were intensive, all-day-and-evening sessions. Computer conferencing provided a continuous linkage for this group, but it was clearly mixed with the continued usage of other media.

A similar group, sponsored by the United States Geological Survey (USGS), was international in scope. The group focused on discussions of a mineral data-base system called GRASP, with which all of the participants were involved. This group has used PLANET for nearly two years now. While only 5 to 20 participants have been actively involved, a cohesiveness has emerged which is consistent with the definition noted above for a "community." The group members have developed a commitment to working with each other; this commitment is shown in their regularity of participation, as well as the comments in the conference proceedings. The topics have varied (around a general theme), as have the leaders. There has been no overt mandate for the group, but the perceived need to communicate is obviously quite high. Since the participants are in very different time zones, computer conferencing, with its asynchronous capability, has apparently provided a bridge across the time and distance barriers. Furthermore, all the proceedings have been in English, and the print-based character of the medium has lessened problems which might have developed concerning accents.

A third group with traces of the "community" style is actually based upon a somewhat radical idea: that a scientist can go to a remote region of Montana and still work closely with researchers on the East and West

coasts. With terminal in hand, a USGS scientist moved to Montana almost a year ago. PLANET has been a significant medium for his continued work. While burdened with logistical problems, such as having to make a long distance call to reach the nearest access point to the computer network, he is nonetheless continuing to work remotely. This is a small conference but does suggest a potential use of computer conferencing to dramatically alter working patterns. Computer conferencing does not automatically make such an arrangement work; there are certainly problems in developing such a communications community. And, in the case of these particular conferences, the possibilities have only been hinted at. Still, the hint is enough to arouse interest and suggest the need for further exploration, which will almost certainly occur over the next few years. The importance of cohesiveness and morale to research productivity, as suggested in Chapter I, indicates that further exploration of this computer conferencing style could prove very beneficial.

The Seminar

> [The Seminar] addresses a specific topic. The most common example is the research seminar or open conference which involves asynchronous usage, possibly with periodic synchronous interaction, and which lasts approximately two weeks to a month.*

Experience since this definition was written only serves to reinforce the notion that the "seminar" is a distinct computer conferencing style. The most important aspect is the focus on a specific topic, usually for a prespecified period of time. A seminar can last from several days to several months and will often have a single leader. Synchronous periods usually occur and are more frequent than in the "exchange" or "community" styles; they are sometimes even used as a tool by a leader in order to build a greater sense of interpersonal interaction. There are generally a higher number of messages sent per given time period than is common with other computer conferencing styles. Generally, the clearer the task (and the greater the commitment to accomplishing it), the more successful the "seminar" will be.

---

*Jacques Vallee et al., *Group Communication Through Computers, Volume 3: Pragmatics and Dynamics*, p. 15.

A rather dramatic example of a "seminar"-style usage comes from the activities of a group within ERDA called the Network Investigators Panel. Their role has been to explore the potentials for the use of computer networks within ERDA--particularly for interlaboratory coordination. Thus, it was very appropriate that they should hold a large portion of their discussions over PLANET, on a computer network with participants from several laboratories and universities.

The Network Investigators used PLANET for about 10 months, in what probably would be called a "community" style, with about 15 participants. (See Appendix C, page 145, for usage statistics.) The "community" emerged gradually as the group developed its own purposes and structure. This 10-month period provided a strong foundation for a remarkably intense group communication period to follow. Participants shifted into a version of the "seminar" style noted above, with the major impetus for this shift coming from the need to generate a report on their activities by a prespecified date. As the date approached, their activities increased drastically (see Appendix C, page 144). It was clear that the only way that the report could be finished in the allotted time was to use PLANET heavily, coupled with text editing of the draft report (again over the computer network), and Express Mail deliveries between sites as necessary. In the words of the organizer, the group was "deadline-driven" and used computer conferencing in concert with other media to meet the deadline. Telephone calls were sometimes used to discuss delicate matters, and to "soften" or explain computer conference messages. Express Mail, with its guaranteed overnight delivery, provided an effective way to exchange report drafts. The final report which this group authored describes their experience with computer conferencing as follows:

> A much higher quality report was produced than could have been possible using conventional methods (i.e., typewriters and the Post Office). In addition, the work was accomplished in a much shorter time than would have been possible otherwise. Only three face-to-face meetings were required from inception to completion (a period of about 6 months). This was largely due to the effectiveness of the PLANET teleconferencing system as a coordination tool. PLANET also minimized the number of lengthy phone calls between participants. From the time the decision was made to use network facilities to produce the report, to the

printing of the first version of the completed report, was less than 3 weeks.*

There was a strong leader during the report-writing phase, and his role was critical to the outcome. All of the participants, though, were highly committed to the outcome and strongly focused on the task at hand. The length of the conferencing period was clearly defined by the due date for the report. The resulting communication was highly intense but apparently rewarding in terms of the end product.

Another group with a common writing assignment was sponsored by the Charles F. Kettering Foundation. It was a group of food/climate scientists located throughout North America who were engaged in writing a joint proposal. The group had met previously and used computer conferencing as an additional medium for a three-month period. There were about 10 participants who used the medium at least once every three days during the period. Those who used it daily made by far the most entries (see Appendix C, page 141). There was a strong leader who orchestrated the meetings and kept the discussion focused. A report and proposal were generated, based largely on discussion arising from the computer conference.

The conference was conducted in spite of a number of problems. For instance, one Canadian participant had a difficult time even reaching the nearest access point to the computer network. Also, there were several instances where surrogates participated in place of specific scientists, causing a sense of frustration and remoteness for those who actually did participate. These problems, however, did not block the three-month communication activity which developed. It was basically a "seminar"-style conference, with a written report as the focus.

Another group sponsored by Kettering Foundation was associated with the Colorado Plateau Research Project (CPRP). This group used PLANET for a three-month period after the food/climate group discussed above, but they

---

*General Purpose Computer Networks and Resource Sharing in ERDA, Volume 3: Remote Resource Sharing Experience and Findings, Working Group on Computer Networking, Mathematical and Computer Sciences, Office of Engineering, Mathematical and Geosciences, Division of Basic Energy Sciences, ERDA.

were quite disappointed in the results. Their tasks were not clearly specified and terminals were only available for six of the 13 institutions involved in the project. Furthermore, the leadership role was never clearly specified and no one actually claimed that responsibility. The conference staggered on for almost three months, but it was clear that the participants were not fully involved in the proceedings. It was a "seminar" without the necessary driving forces of a focused topic and a strong leader. In a few specific cases, the medium did provide a direct utility. (For instance, a table of numbers was sent via PLANET, where the participants had experienced a great deal of trouble with using the mails.) However, on the whole, the use of the medium did little to help the progress of the group.

The National Coal Assessment Water Group of ERDA had similar problems in their attempts at using PLANET. At one point, a draft document was inserted in a conference for review, but there was not enough focus to the activity. Periodic face-to-face meetings, supplemented by letters and telephone calls, were performing the communication which *needed* to happen. Apparently PLANET was simply not needed, or at least the need was not perceived by the group members. The group's use of PLANET began slowly and went downhill.

Another ERDA group offers an example of a very successful ad hoc "seminar" without a specific end goal. The members were discussing county-level data bases on various energy-relevant topics. The conference was organized by a leader of another PLANET group within ERDA and included a number of participants involved in various other PLANET groups cited in this report.* The conference, lasting about three weeks, was an intense information exchange for persons involved in research regarding county-level data. Learning of other people's work could save efforts in developing new approaches, so the need to communicate was high. While there was no group product to be produced, the organizer only invited participation from people with a

---

*We have found that it is difficult to keep computer conferencing groups from talking to each other, especially if they have similar interests. We did not encourage such overlap because of the evaluation design, but it seemed somewhat inevitable. In this case, participants from USGS "met" people from ERDA over PLANET and developed new channels of communication. Several participants simply asked Institute staff if there were other PLANET users who had interests similar to their own.

specific interest in the topic area. He preset the time period at two weeks and extended it to three weeks by popular demand. The success of the conference was measured (at least in part) by the number of useful new contacts which individual researchers made, and this appeared to be a significant number.

The Assembly

> [The Assembly] is an extension of "The Seminar." The group can be very large (up to hundreds or even thousands of users), and multiple topics, all related to a single general theme, are considered in separate parts of an agenda. This is the style of a "general assembly" of a major professional society, in which papers are presented, panels respond to questions from an audience, and general discussion takes place.*

The original conception of the "assembly" was as a complex "seminar." The original FORUM conferences only hinted at a computer conference of this size and complexity. However, since it seemed distinctly possible, it was labeled as a separate computer conferencing style. The current test groups have not added much to knowledge about this style. While we still deem it possible, there was only one modest attempt among the groups in this study.

The IWGDE group, mentioned earlier, did divide itself into a series of three to five topically oriented conferences. These were, in effect, separate "seminar"-style conferences for a single group and thus approach our definition of an "assembly." However, there was still a relatively small number (never more than about 30), and the usage never grew at a rate consistent with the definition noted above. The IWGDE was more of a "community" than an "assembly." Perhaps it is necessary to reach a "critical mass" of key participants focused on a particular spectrum of topics in order to achieve an "assembly." We really do not know at this point, since the field tests to date have indicated more apparent potential than documented reality.

---

*Jacques Vallee et al., *Group Communication Through Computers, Volume 3: Pragmatics and Dynamics*, p. 15.

The Encounter

> [The Encounter] represents the closest computer analog of a face-to-face meeting, in which participants are synchronously discussing a topic for a short time (usually a few hours), possibly with role assignments among the participants (as in simulation and gaming) and with some degree of intensity.*

It is certainly possible to hold "encounter"-style computer conferences, but the current study had no examples. Actually, synchronous conferencing (when more than one participant is present simultaneously) may be more an option within other conferencing styles than a style in itself. There may be cases where a synchronous conference will be held for its own purposes and conforms to the definition noted above. But it seems that this style will occur only rarely--at least according to field test experience to date. Many groups do use synchronous conferencing, whether by plan or by simply finding others present. But this process probably doesn't warrant a separate style designation. It is more likely to be blended with other styles.

The Questionnaire

> [The Questionnaire] involves an unlimited number of participants in a structured question-and-response format. The most common application of this conferencing style is the questionnaire survey, with Delphi and open voting at opposite ends of the spectrum of possibilities. Typically, no direct message exchange is allowed among participants, whose responses are entered anonymously. The conference may last from a few hours to a few weeks.**

Like "the encounter," it now seems to us that "the questionnaire" is more a tool to be used within other conferencing styles than a style in itself. In the conferences reported in this report, several groups made frequent use of the questionnaire option within PLANET.*** The Network Investigators, mentioned earlier, frequently used the open-ended question format as a way of making sure everyone was on-the-record in responding to

---

*Ibid.

**Ibid.

***This option allows secret ballot voting, multiple choice questions according to any desired scale, and Delphi-style questions. Responses are then analyzed by the program, and results can be inserted into the proceedings.

certain questions. (The system would then automatically pose the question to each person as they arrived, asking them to make a response of any length they chose.) This group felt that voting or multiple-choice questions would be too limiting. The IWGDE also used this approach, as well as secret ballot votes as appropriate. The questionnaire option was thus a useful tool in certain instances but was never used as a response elicitation device, as implied by the definition given above.

Ironically, the first uses of computer conferencing, both at the Office of Emergency Preparedness and at the Institute for the Future, were for automated questionnaires. It now seems that this approach is rarely used, at least in field test groups such as those discussed here. The capability of asking questions systematically to all other participants is sometimes useful but in a flexible fashion mixed with open text conferencing.*

SUMMARY OF GROUP CONFERENCING STYLES

The current project has revised somewhat the original formulation of computer conferencing styles as noted in the Institute's 1975 report. The primary styles used by the current groups are summarized in the box at the right.

We have concluded that the style previously identified as "the assembly" (a complex seminar) did not occur during this project, though it still remains a possibility. The same could be said for the "encounter" and "questionnaire" styles. However, it now seems more appropriate to consider these two modes as tools likely to be used in the context of other computer conferencing styles.

---

*It should be noted that the design of a computer conferencing system will have direct effects on how questionnaires--or other features--are actually used. The structure of the PLANET system encouraged a mixing of questionnaires with open discussion. This design was certainly a major factor in the ways in which questionnaires were actually used by the field test groups.

MOST FREQUENT CONFERENCING STYLES FOR TEST GROUPS

Exchange: asynchronous; low social interaction; relatively constant participation rates; continues over a period of months; many participants; varied topics; high need to communicate or instruction from superior to do so; more commitment to subject than to other participants.

Community: asynchronous; frequent social interaction; relatively constant participation rates; continuous over a period of months; varied leadership; high commitment of participants to the group; usually less than 15 active group members; common theme but varied topics.

Seminar: focused and purposive; high participation rates; strong leadership; defined time period, usually less than three months; frequent periods of synchronous conferencing.

These styles are *not* always discrete; they will frequently overlap or develop through various phases. Such designations merely begin to map the possibilities for computer conferencing usage, based on the research groups involved in this project. However, the long-term effects of the medium will not be codified by the technology but created by the users themselves. Computer conferencing groups are likely to move through varied phases in their usage, possibly involving more than one of the styles described here. Also, it is likely that a serendipitous quality will occur--meaning that the exact usage pattern of a given group will be unpredictable until they are actually involved in the experience. And at least *some* usage styles will resist classification.

PARTICIPANT CONFERENCING STYLES

Just as group conferencing styles are important in assessing computer conferencing usage, so are the styles of individual participants. Individual participant styles have not previously been examined, but the current study gives us the basis to do so--at least tentatively. Also, discussing participation styles allows us to describe the ways in which individuals used PLANET in this study without identifying them by name.* Participant styles refer to the ways in which individuals used computer conferencing.

In our analysis of these field tests, we attempted to develop a typology of styles parallel to the group styles noted earlier in this chapter. Early drafts of this report identified six styles representing typical individual usage patterns which we have observed. However, we have since decided against this categorization, because there is too much variation among individuals--or even in the ways a single individual might use this medium--to justify a simplistic typology. Rather, we have sought to give *examples* of the ways in which individuals have used PLANET. A particular person may use varied approaches at different times, depending on the communications context with which he or she is involved.

In a few cases, we did find individuals who seemed to be "natural" matches or mismatches for computer conferencing. The "matches" were people for whom this medium allowed a new freedom of expression or where it fit unusually well into the working patterns they preferred (e.g., working at home or at unusual hours). Of the several participants with whom this occurred in the current study, all had a good deal of computer experience before using PLANET.** In computer conferences, these people seemed to emerge as leaders, which was not necessarily so when they met with the same group face to face. Natural "matches" could also occur (though they did

*A list of all the participants in the study, as well as selected transcripts and all basic data collected for this study, is available by arrangement from the Institute. However, we have not identified individuals by their usage patterns or personal responses in questionnaires or interviews.

**Such experience does not, however, assure a match. Many computer experts find PLANET too simple and too heavily oriented toward novice users.

not in this study) for participants with language problems or physical handicaps which might inhibit their effectiveness in face-to-face but would not be visible over computer conferencing. The point is that a small number of people (perhaps 2 to 5 percent) seemed to adapt immediately to computer conferencing, and it provided a dramatic increase in their feelings of accomplishment and satisfaction. Such individuals use the medium quickly and constantly; it readily becomes part of their normal work habits.

We have noticed that a few of these computer conferencing "naturals" develop what might be called a more-the-merrier syndrome. Since computer conferencing is so rewarding to them, they sometimes issue broad invitations for others to join in. Such a stimulus, while potentially useful to allow more people to keep up with the discussion, can cause problems if more new participants are invited than can reasonably take part. Participants can become spread too thinly across a number of computer conferences, or a given conference may grow too quickly to efficiently integrate all the new participants. Thus, it is important to monitor--and sometimes even constrain--the initial enthusiasm of some new computer conference users.

On the other extreme, a small group of study participants seemed to have a basic "mismatch" with the characteristics of computer conferencing. These people (only about 5 percent of the test group but possibly indicative of many more who would not even consider using such a medium) had developed a successful work style--often over a period of many years--which was antithetical to the approach required by computer conferencing. For instance, many managers make heavy use of telephones and, in a sense, orient their work around responding to such "interruptions." Leaving their office for awhile, they likely return to a stack of telephone messages to order and answer. Computer conferencing has no equivalent to a ringing telephone; participants must structure their time so that they regularly check into the conference. Also, in a field test such as this, the busy manager will have both the usual barrage of telephone messages *and* the requirement to utilize a new communications medium. It is not surprising, therefore, that some are unwilling to make a fundamental change in their communication patterns; perhaps they should not. If the change to computer conferencing is to be made, there will be a strong need for a transition period from the old

communication pattern to the new--probably requiring strong support from top management. The switch will not be trivial for those whose existing communication patterns strongly contrast with those called for by computer conferencing. In at least one case during our study, an acknowledged leader of a face-to-face group did not maintain the leadership role, while the rest of the members used computer conferencing as their primary channel of communication. For this person, the change simply was not worth it, though he would still be a leader in a face-to-face meeting of the group.

Between the extremes noted above, there are a variety of ways in which individuals react to and use computer conferencing. Descriptions of these approaches follow below.

PARTICIPANT STYLES: SOME EXAMPLES

Computer conferencing does not require anyone to "speak"; and it is easy to bypass even direct questions, unless the questioner or the leader is very persistent. This situation clearly contrasts with a face-to-face meeting or a telephone conversation, when a direct question must be responded to within seconds. On the other hand, there are definite similarities to face-to-face meetings in which a few participants dominate the conversation while the others listen and only occasionally make comments. In computer conferencing, a participant style can develop in which someone uses the medium regularly (i.e., in a high number of sessions) but rarely makes any substantive contribution. This role, while rather passive, allows a participant to keep up with the activities of a group and not be conspicuously absent from the proceedings. Of course, other group members may become concerned over such a role (e.g., seeing it as a form of "eavesdropping" or not contributing one's share), but we have seen several groups where there is no pressure to contribute. In fact, there were cases where a special "listener's" role was actually suggested, enabling people to keep up with the activities of a group without feeling obliged to contribute. Such a role proved useful for several managers who wanted to follow the progress of a group without becoming directly involved. Some participants

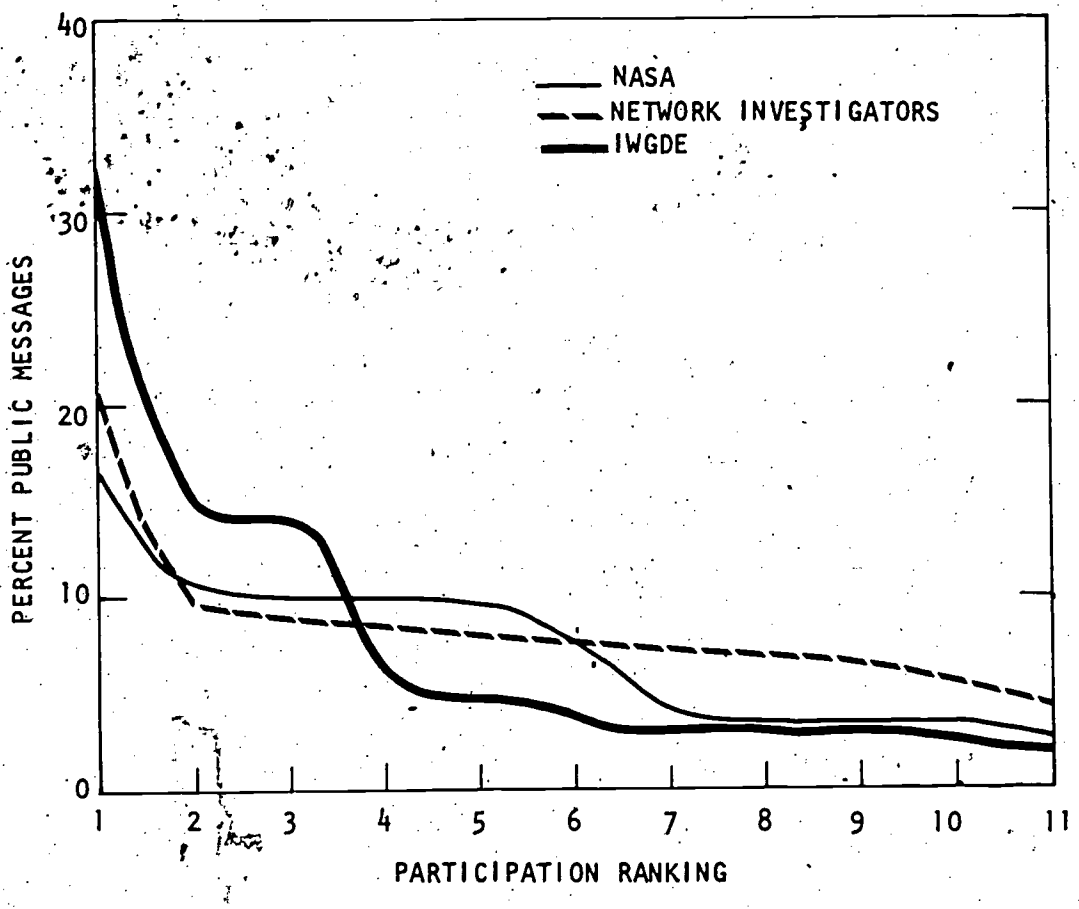
prefer to listen more than they "talk" in computer conferences; others play the opposite role and contribute vigorously. And while computer conferencing offers no technical limits on the volume of information which can be entered by a given participant, there are certainly limits to how much other participants will be able--or willing--to read. Long textual entries can easily become fatiguing for computer conference participants, especially if they are made in more than one conference. Of course, it *is* possible to simply ignore some entries, and we have seen examples of verbose participants being subtly excluded in spite of their voluminous entries. More likely, however, persons who make many entries will have a commanding--though possibly stultifying--effect on the proceedings.

While computer conferencing *allows* an equal amount of participation by all those involved, we have seen few examples where such equality has actually occurred. In practice, a few people usually make most of the entries--just as a few participants generally dominate face-to-face meetings.* As Figure 1 shows, however, the equality of participation rates can vary considerably from group to group. (The distribution for the Network Investigators is the most equal we have ever seen for a major computer conference.) The important observation here is that *some* unevenness in participation rates appears normal in computer conferences. Whether or not a particular person or persons are perceived as overly verbose is more likely dependent on the quality of what he or she says, rather than simply the length of his or her entries in the conference.

A significant number of computer conference users are likely to be made self-conscious by the characteristics of the medium. They may be hesitant about their spelling, grammar, or typing. Also, they could be somewhat intimidated by the limited amounts of interpersonal feedback:

*We have made earlier studies of this apparent similarity, with the further qualification that synchronous conferences seem to encourage more equal distribution in participation rates than do asynchronous conferences. See Jacques Vallee et al., *Group Communication Through Computers, Volume 3: Pragmatics and Dynamics*, pp. 123-5; see also Jacques Vallee et al., *Group Communication Through Computers, Volume 2: A Study of Social Effects*, pp. 47-9.

FIGURE 1. PUBLIC PARTICIPATION RATES FOR THREE DIFFERING GROUPS



there will be no reassuring glances or nodding heads in response to what they are saying. The simple editing features available in PLANET--or the more powerful editing available in other systems--provides one measure of the degree of this self-consciousness. Some people will quickly adapt to message-sending without regard to exact spelling or sentence construction; others will strive for a perfection in self-presentation which is likely to restrict their ability to participate in this medium. If participation is primarily asynchronous, however, even a self-conscious or shy person may have the time for careful composition and end up as a strong contributor.

It is noteworthy as well that some persons, far from being particularly self-conscious, may actually be inclined toward *greater* self-expression via this medium. While we have rarely seen such participants, the ease in communicating to others via this more "anonymous" medium may be an important catalyst for some participants.*

Others, who may not converse extensively on a public basis, will engage in many private communications with individual participants. It is possible in most computer conferencing systems to send private messages, for which no record is kept. While we did not have access to the text of private messages during these field tests, usage statistics did show when participants had low public but high private sending patterns.** An individual could participate at minimum levels in the public mode while using the private mode as the prime substantive channel. We observed instances where group leaders used such an approach to encourage participation. One could also imagine when such a style might be very useful for bargaining or negotiation. Social mores might develop around the use of such a "secret" style, but it does not necessarily have sinister implications. It is

---

*Roxanne Hiltz has suggested that this comfort is similar to that of the comfortable "stranger" noted by Simmel (1950). See R. Hiltz and M. Turoff, *The Network Nation*, Addison-Wesley, forthcoming.

**It is interesting to speculate about the role of usage statistics in the dynamics of computer conferences. For instance, if some participants had access to such statistics, they would know that private communication was going on--even if they didn't know the substance of the exchanges. Thus, access to usage statistics--or even whether they are allowed to be kept--could be a major issue in the use of this medium.

simply a communication style which is easily pursued in computer conferencing but often difficult via other media.

Persons who, from time to time, want to remain behind the scenes in a computer conference may develop an indirect style of communicating. In a computer conference (given current technology), one is never really *sure* that a person at another terminal is actually who the system says it is. There are individual passwords for each participant, but these can always be exchanged, facilitating a common--and sometimes confusing--style of indirect participation. We have seen at least two types of indirect communicators during these field tests:

1. *Multiperson terminal use.* In a number of cases, more than one person used the same terminal, either all logging in under one person's name or exchanging names. A participant might announce such a situation by saying: "Any message I receive, Joe will also see, since one of us goes by his office several times a day. If you have a private message for him, let me know and he'll go in himself." In some cases, private messages were sent to one person for delivery to a third party.

2. *Use of surrogates for entering and retrieving messages.* In a number of cases, secretaries or assistants actually typed in and retrieved messages for someone, though often they did so under the name of the indirect participant. This works quite well in many cases, particularly if a participant is very busy, has trouble accessing a terminal, or is simply not inclined to use keyboard devices. However, we saw several instances of confusion and frustration where other participants--not realizing that it was a surrogate and not the "real" participant--would enter private messages and not receive responses. (Sometimes the surrogate would become flustered or embarrassed and not know what to do in response to the message.) Such a situation can easily lower trust within a group.

It seems that indirect communication has some advantages but can easily have negative effects on the interaction. It adds complexity to the group

and takes the indirect communicator a step away from the other participants. Such a usage pattern is workable, but it requires a great deal of attention to the possible effects on the group as a whole.

* * *

The above examples provide some feeling for the ways in which PLANET was used during these field tests. Chapter IV will provide more detail about individual usage as it relates to the needs of a conference organizer. At this point, it is most important to realize simply that the ways in which a given individual makes use of computer conferencing is likely to vary considerably, and the nature of this variation will have much to do with the outcome of the communication which occurs. The group and individual usage styles which occurred in this study confirm a theoretical observation made early in the development of computer conferencing: that this medium cannot be assessed without carefully considering the individuals and groups using it, the tasks for which it is used, and the procedures which are employed in arranging the meetings.* Just as the literature reviewed in Chapter I emphasized the importance of group structure, so the structure of computer conference usage seems critical in determining overall results.

*See Jacques Vallee et al., *Group Communication Through Computers, Volume 2: A Study of Social Effects*, pp. 20-6.

III. EFFECTS ON WORKING PATTERNS

The "bottom line" of this project focuses on measurable and potential effects of computer conferencing on the working patterns of the test groups. In analyzing the project data for this purpose, we combined questionnaire responses for similar test groups to provide a statistically sound basis for our conclusions.* (It would have been more desirable to examine changes in questionnaire responses on a group-by-group basis, but irregular response rates made this difficult.) An ERDA group was created by combining the responses of individuals in Network Investigators, Network Objectives, Berkeley Data Management System, and Interlaboratory Working Group for Data Exchange. These groups contained many individuals who participated in multiple conferences and were part of the same government organization. A USGS group was formed from GRASP and Remote Office for the same reasons. A final consolidation included all "low-usage" groups. This group included individuals in NCA:Water, NCA:Health, Colorado Plateau Research Project, Earthquake Prediction, and Network Objectives. It was especially necessary to consolidate low-usage groups because of the lower response rate among participants in these conferences. In combining low-usage groups, we assumed that common characteristics might exist among individuals who did not adopt computer conferencing as part of their work patterns. The NASA/CTS group was considered separately, since it was a very different group and also had a high questionnaire response rate.**

As a framework for organizing our findings, we have delineated four aspects of working patterns which could be affected by computer conferencing.

---

*The particular data analysis procedures are described in Appendix F.

**The Kettering Food/Climate group is not included in this time series analysis, since their usage period was only three months. Thus, only their open-ended questionnaire responses are considered.

These include: with whom people work, when they work, where they work, and how they work. Also, in a few cases, it was possible to identify end products which seemed to result from computer conference usage. While these outcomes are certainly not simple measures of research productivity, they do provide more detail on the context in which this project occurred.

This chapter first describes the measurable and potential effects on working patterns observed during the study, then examines those end products which did result. Table 4 summarizes the discussion of effects.

WITH WHOM PEOPLE WORK

In a field such as energy research, a broad range of potential working relationships exists. Typically, however, working groups are located around large laboratories or universities. In many cases; similar work is conducted in different locations, but the researchers involved may have little or no awareness of the overlap. The logistics of communication across large distances has made continuous working relationships difficult. In certain cases, this separation can be justified by the potential it offers for diverse and independent thinking. However, a strong argument can also be made--as was pointed out in Chapter I of this report--that increases in communication with other researchers are usually associated with increases in research productivity. The variety of contact facilitated by computer conferencing is often impossible to obtain within one's own organization or locale. The question is whether those researchers who had access to computer conferencing increased their contact with distantly located researchers in the course of this study.

On the other hand, researchers may want to *limit* the number of persons with whom they are in contact, or at least have more control over the nature and timing of the interactions. Information overload is certainly a possibility among energy researchers, who often have no effective ways of controlling the number of outside stimuli to which they must respond.

TABLE 4. SUMMARY OF EFFECTS ON WORKING PATTERNS SUGGESTED BY THIS STUDY

	RANGE OF OPTIONS	DOCUMENTED EFFECTS	POSSIBLE EFFECTS
WITH WHOM PEOPLE WORK	Nearby colleagues Distantly located colleagues Persons from varied disciplines Persons of varied quality	More communication with distantly-located researchers Expedites communication among those interested in communicating (requires high communication need)	More international communication More geographically-separated working groups Information overload
WHEN PEOPLE WORK	Office hours Evenings Weekends Simultaneously with others Irregular times	Often used outside office hours (25-40% of the time) Participants continue to work outside office hours, apparently assisted by access to computer conferencing Participants can "meet" without being present simultaneously	More flexibility in working hours Longer working hours
WHERE PEOPLE WORK	Office Home While traveling Neighborhood office center Remote retreat	Work at home is common when terminals are available Researchers can stay in touch while traveling, moving, or homebound	More variations in where researchers live and work Less office-based research
HOW PEOPLE WORK	Face-to-face Mail Telephone Video teleconferencing Audio teleconferencing Computer-based teleconferencing	Computer conferencing is perceived as more productive in some instances than mail or telephone Can be used for joint authorship, information exchange, scheduling, planning, and follow-ups for face-to-face, as a bridge to other computer resources	Substitute for some mail usage Substitute for some telephone usage, but could also add new uses for telephone Could even *increase* travel

Researchers in Other Locations

Figure 2* displays the changes in respondents' assessments of how frequently they communicated with national researchers (i.e., those in other parts of the United States) during three questionnaire intervals during this study. For the ERDA groups, it is clear that statistically significant increases in communication with national researchers occurred between each questionnaire.** (From less than twice a month to more than once a week.) This is an important finding, since the first sample for these groups came before they began using PLANET.

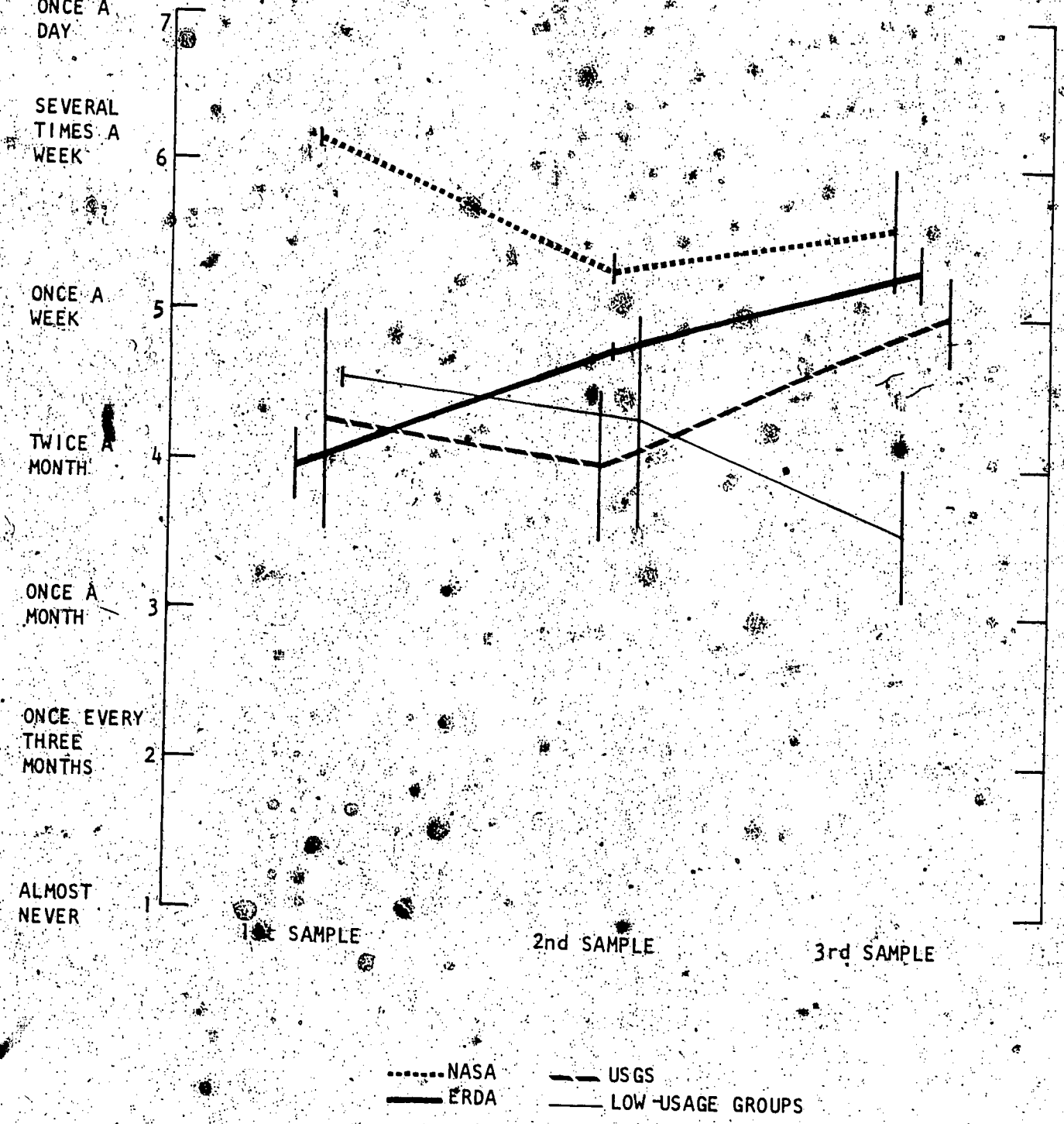
The same increase in contacts did not occur for all the test groups. The NASA group, while beginning at a mean frequency of more than several times a week, dropped to slightly more than once a week. While this drop is statistically significant (see Appendix G, page 169), the NASA group was high on the frequency scale to start. Also, no pretest was possible with this group, as they had already been using computer conferencing at the time of the first sample. Thus, even with a drop in frequency, their contact with national researchers is still at a relatively high rate.

The timing of questionnaires for the USGS groups (see Appendix G) was the same as that for the NASA group. No pretest was possible, and they had

*The lines connecting the three samples show the general movement of responses between questionnaires. Rather than showing group means for each questionnaire sample, we judged it more valid to examine changes in individual responses. Thus, we have calculated two separate means for each sample, as represented by the points at each end of the vertical lines. These two means are calculated by considering only the participants common to the base sample and either of the other two samples. For example, the ends of the vertical lines in the first sample column of the figure represent (1) the mean response for those participants who answered both the first and second questionnaires and (2) the mean response for those who answered the first and third questionnaires.

**Appendix G contains the basic information about changes for each group over the three questionnaire periods, as well as significance tests. One of the limitations of questionnaire used in this research design is that changes in frequency can occur which may not be directly related to media usage. The design assumes that such outside factors will be detected by open-ended responses, interviews, or observations; but this will not always be the case. These test groups operate in a distinctly "noisy" environment for identifying measurable effects.

FIGURE 2. REPORTED FREQUENCY OF COMMUNICATION WITH NATIONAL RESEARCHERS



been using computer conferencing for some time when they received the questionnaire. Their initial frequency of communication with national researchers was considerably lower than the NASA group's. It remained relatively steady for the second questionnaire. A noticeable increase is shown between the second and third questionnaires, though the increase is not statistically significant.

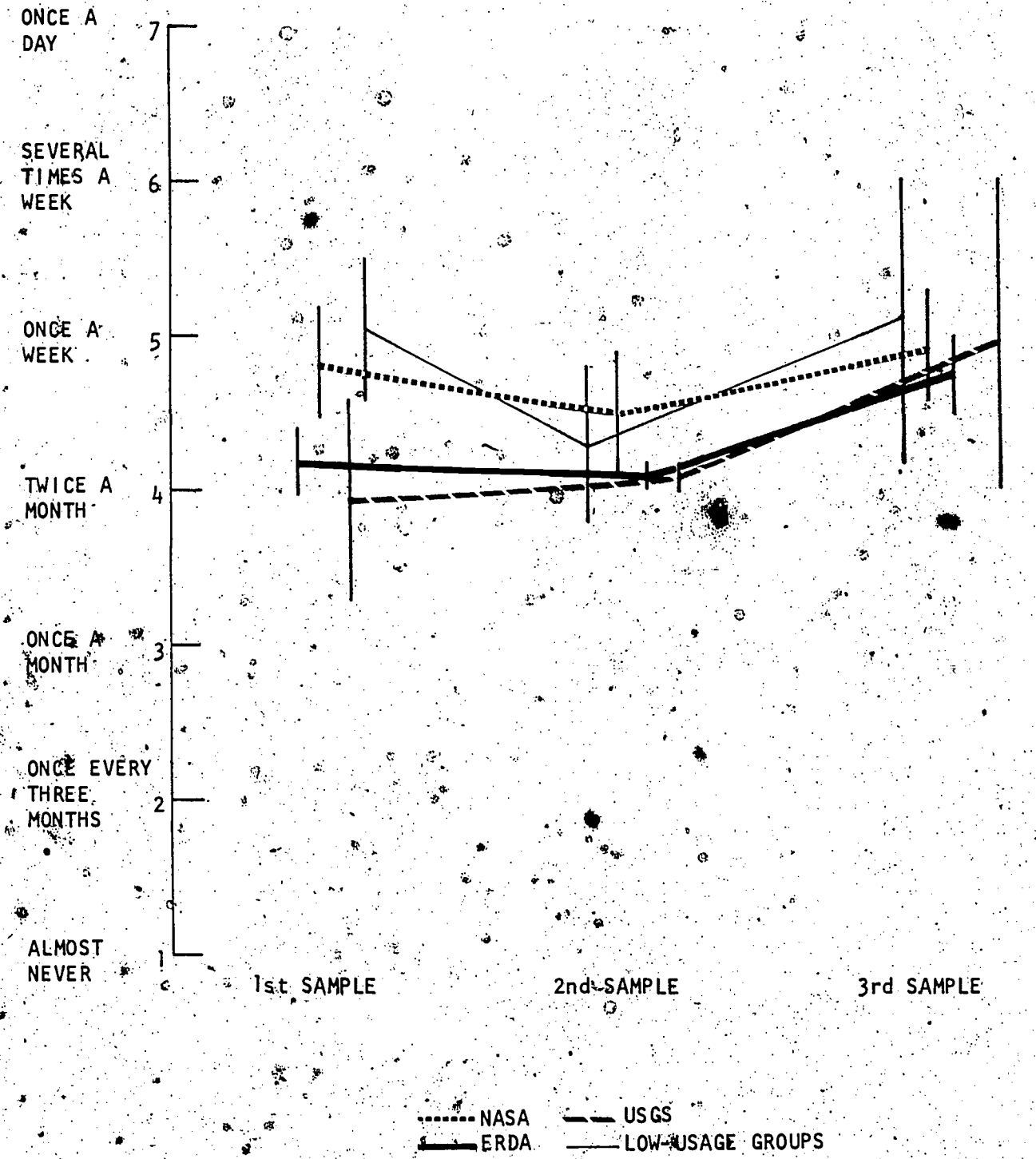
One USGS group, GRASP, showed a significant increase in communication with *international* researchers. Since pretest data is not available for this group, the questionnaire results do not show an increase directly linked to computer conferencing usage. However, there appears to be an increase in international contacts for the group when they began using PLANET. While the GRASP group is small in number and the only international group in the study, the potential of computer conferencing to further international contact is worthy of further exploration.

The low-usage groups showed an apparent, though not statistically significant, drop in the frequency of their communication with national researchers (see Appendix G, page 175). For most of these persons, the first questionnaire was a pretest. The apparent "drop" could be related to factors other than computer conferencing, such as group dynamics or outside events. The opportunity for communication was technically present for these groups, but no measurable increase occurred.

Researchers in Other Disciplines

Frequency of communication with researchers in other disciplines is another important variable which was tapped by the questionnaires. Again, in the case of the ERDA groups, a clear increase can be shown over the field test period. (See Appendix G, page 171.) An increase was also noted within one questionnaire interval for the NASA group and at least hinted at--though possibly due to other factors--for the low-usage groups. Figure 3 summarizes the differences in mean responses on this question for the four major categories of groups. Failure to show an increase in frequency could be due simply to the fact that no researchers from other disciplines happened to be present during the test period. The ERDA groups' reported increase in contact with researchers in other disciplines may have been due--at least in

FIGURE 3. REPORTED FREQUENCY OF COMMUNICATION WITH RESEARCHERS IN OTHER DISCIPLINES



part--to the addition of USGS reseachers to their computer conferencing experience. This effect occurred without preplanning as the various groups discovered they were all using PLANET *and* had research interests in common.

One imagines that such unplanned contact might occur more frequently among researchers in different disciplines if computer conferencing were more generally available. However, it should be noted that computer conferencing does not always facilitate new contacts. One respondent phrased it nicely on a questionnaire when he said, "[PLANET] has expedited communication between those interested in communicating." If participants do not begin with an active desire to communicate with other participants, this medium does little to encourage it. In fact, it may even encourage more closed communication among a select group of people who form an electronic barrier between themselves and other potential participants--i.e., they could exclude others from joining.

Overall, the questionnaire data about frequency of contact with local researchers and others in one's own organization is mixed and not particularly vivid. (See Appendix G.) The ERDA groups increased contacts with local researchers, but this seems largely due to the close proximity of at least two of the laboratories involved in the conferences. (Livermore and Lawrence-Berkeley are both in the eastern San Francisco Bay Area.) There is some suggestion, though it is not statistically significant, that communication with researchers in one's own organization could even go down during periods of computer conferencing usage. (See Appendix G.) However, this evidence is not convincing in the data presented here and remains largely speculative.

Frequency of contact is, of course, only one aspect of the relationship between colleagues. One must also examine the nature and quality of contact which occurs, as well as the potential for *more* contact that could contribute to increased productivity. It is clear that, for some of the groups involved in this study, a community of contact did emerge and was facilitated by access to computer conferencing. However, this was not always the case, and the effects of access to computer conferencing on working relationships cannot be predicted simply. The medium *can* affect contact among researchers

and did so in measurable ways during this study. But the effect is not automatic or consistent across varied groups of researchers.

WHEN PEOPLE WORK

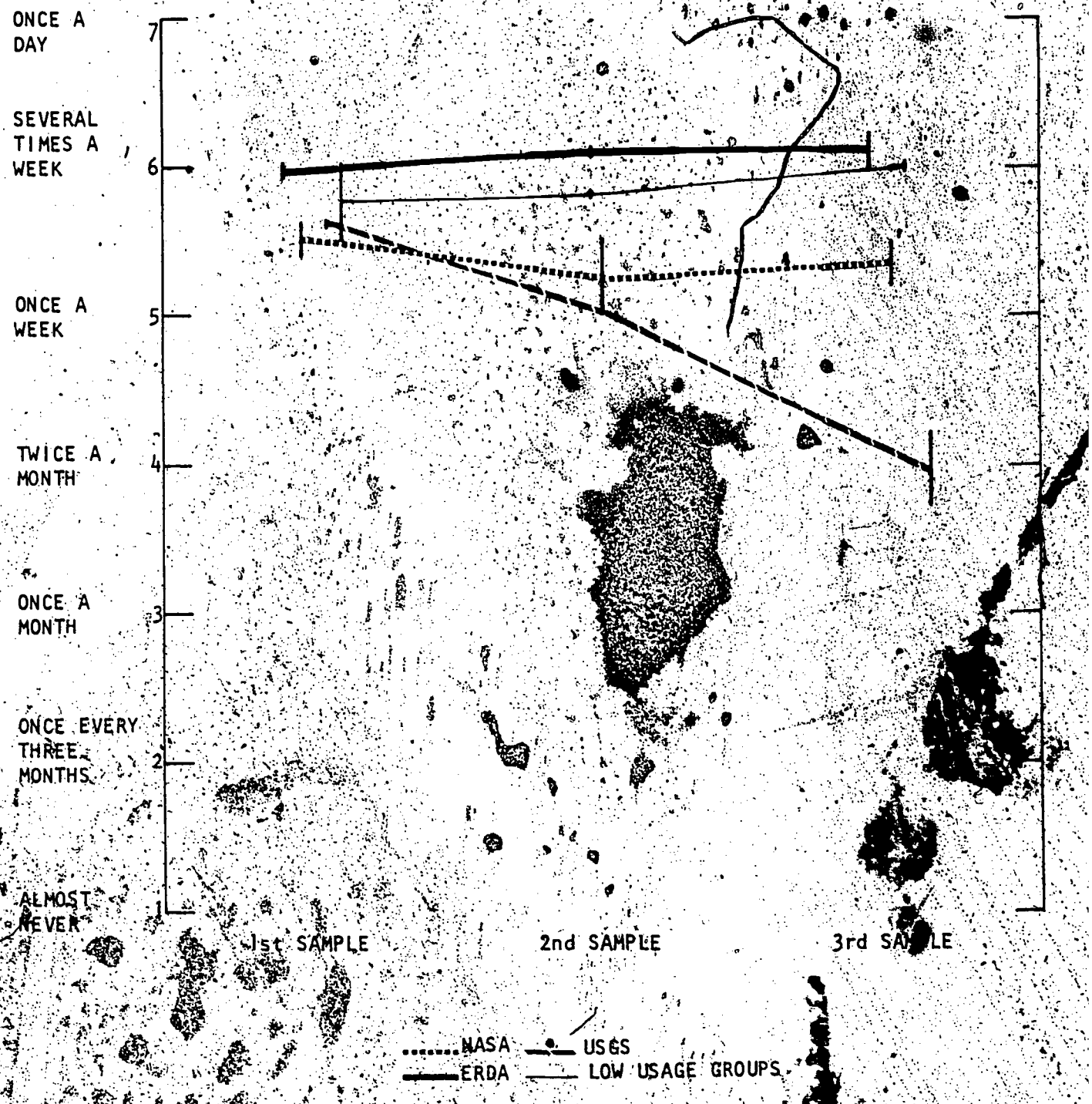
Researchers such as these are typically not confined to specific "office hours." Still, there are several key issues regarding when people work that could be affected by computer conferencing. These include flexibility in working hours, whether or not one must work simultaneously with others, and new ways to accommodate a heavy workload outside normal working hours.

In this project, we had two sources of information about when people worked: questionnaire responses and usage statistics. Evidence from both sources suggests that all the test groups worked outside of office hours for sizable amounts of time, but this is not necessarily attributable to computer conferencing. Only a few participants shifted a majority of their work-related communications to the new medium. Instead, their computer conferencing usage was typically added to their normal working time. Thus, these field tests provide only limited information about the potential of computer conferencing to affect when people work.

The questionnaire data are confusing and help little. Most participants were initially high on the scale for frequency of work outside normal office hours (see Figure 4). From this point on, the data becomes perplexing. Only the low-usage groups increased their frequency of extra office hours (see Appendix G, page 175), and this during a period when their PLANET usage would have been very low. This increase seems clearly related to factors outside the realm of this study.

Another confusing finding is that the NASA group and the USGS groups both had evidence (in the latter case, strong evidence) that *decreases* in work outside normal office hours actually occurred. This could have been related to poor access to computer terminals (often available only at offices). This change, again, seems more likely to be related to factors outside of the scope of this study, such as outside work pressures.

FIGURE 4. REPORTED FREQUENCY OF WORK OUTSIDE NORMAL OFFICE HOURS



The usage statistics demonstrate that PLANET was used substantially outside office hours by all groups, but the percentage of time varied from group to group. Figure 5 displays the percentage of usage which occurred during each month for the three groups. In that figure, "office hours" are defined as 8:00 to 12:00 and 1:00 to 5:00, local time. Often, of course, individuals define their own office hours which, though regular, may vary from the norm. Still, the figures give some idea of usage in relation to typical office hours.

Figure 6 provides more detail on the exact hours of usage for the same groups noted above during their total usage period. As it shows, the majority of communication for most of the groups took place during traditional office hours. However, particular groups had large amounts of usage outside of these hours and on weekends. Access to terminals is a major factor here, of course, and these participants rarely had access to home computer terminals.* But these statistics also suggest that access to computer conferencing is not sufficient to change the times at which people work. Explicit means for organizing such a change must be introduced, along with the technology itself.

There was evidence in the open-ended questionnaire responses that some participants did arrange specific times for their computer conferencing usage. Several mentioned that they checked in early in the morning and late in the afternoon (i.e., at office times). Others said they simply used the medium between other tasks they were performing during the day. In some cases, usage times were related to periods of load on the computer being used; slack periods were used in order to achieve better response times from the computer.**

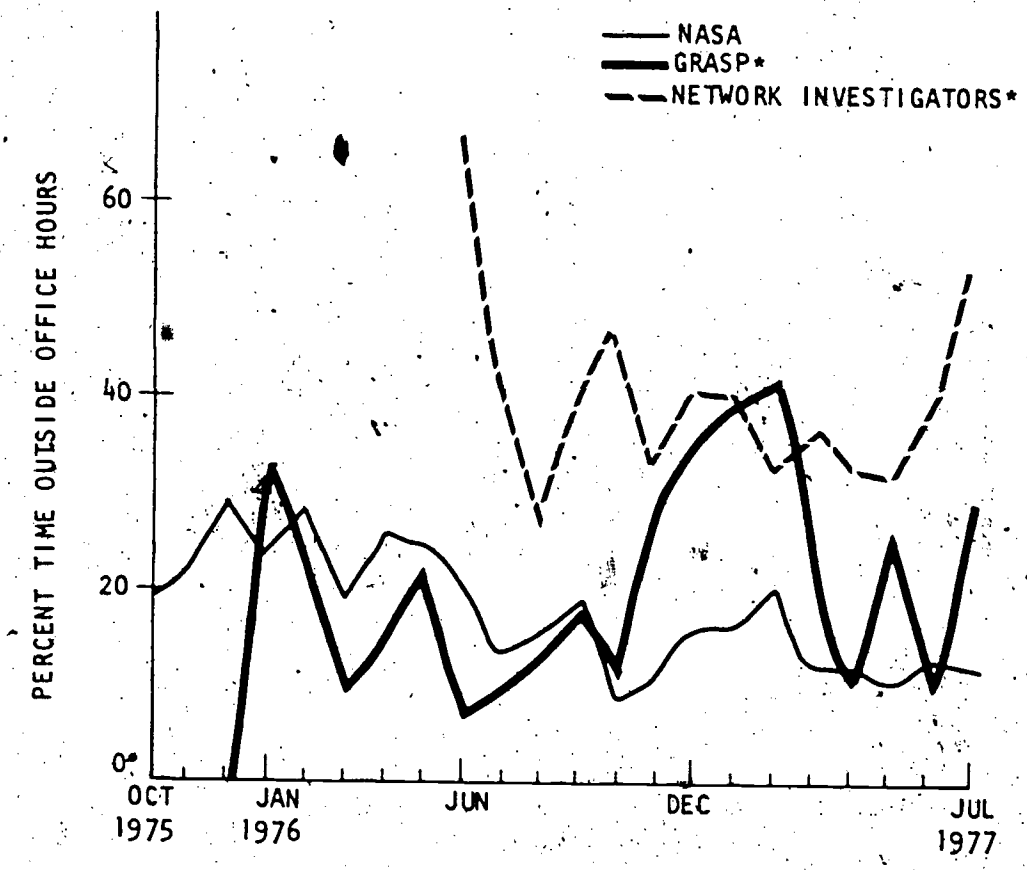
In short, this study revealed there were no measurable effects of computer conferencing on when people worked. Many participants tended to work

---

*This factor will be discussed in more detail under working patterns relating to *where* people work.

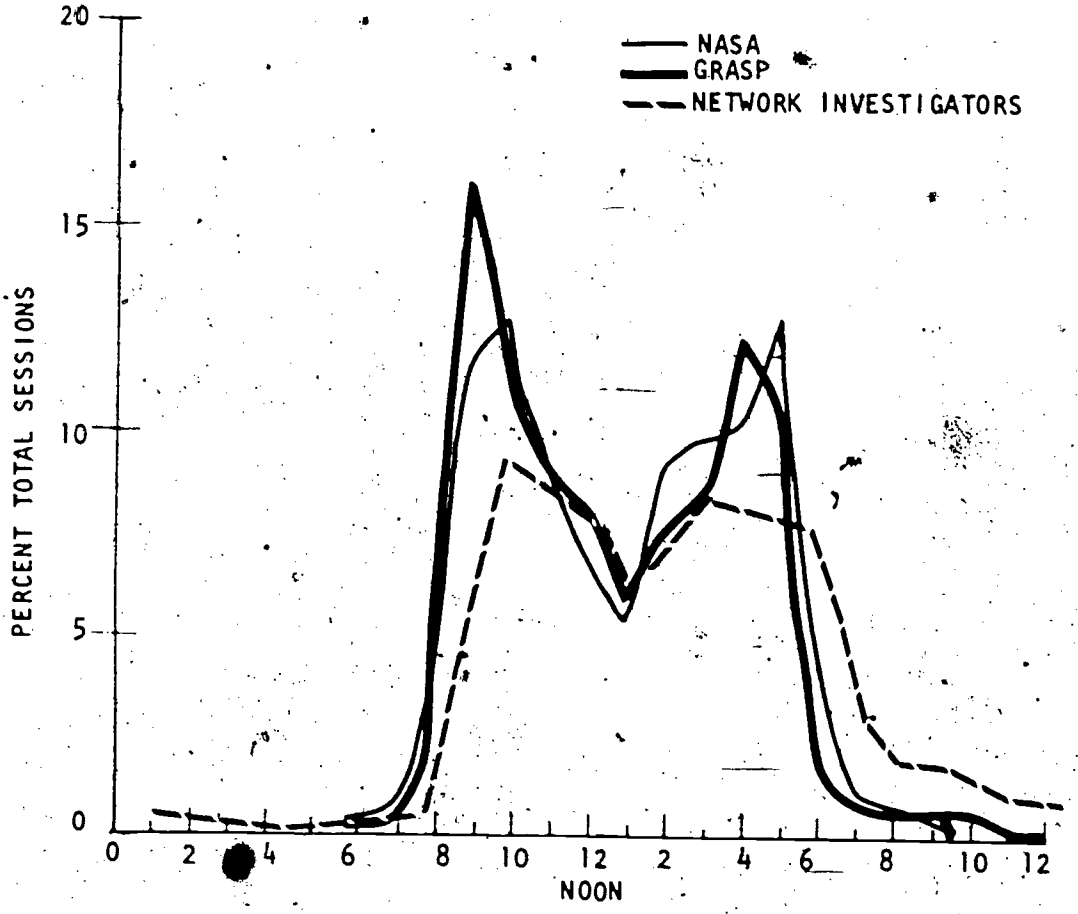
**Long delays can be frustrating to computer conference users. While such problems occurred only rarely in this study, they were serious. One group actually changed computers, but this only added to the confusion. A dependable computer is a requirement for successful computer conferencing.

FIGURE 5. PERCENTAGE OF TIME USING PLANET OUTSIDE OF OFFICE HOURS OVER THE PROJECT PERIOD



*These usage statistics are not grouped by organization, as are the questionnaire responses. This was possible because detailed usage data is available on all groups--even those with low questionnaire response rates.

FIGURE 6. PLANET-USAGE BY TIME OF DAY (IN LOCAL TIMES)*



*The percentage of total sessions on weekends was as follows: CTS = 1.05%; GRASP = 1.60%; NETWORK INVESTIGATORS = 8.3%.

outside of office hours before the project, and they continued to do so while using PLANET. While one can still argue that computer conferencing could provide more flexibility in working hours, there is no quantitative data from this study to support such an argument.

WHERE PEOPLE WORK

An energy researcher might work in a variety of places. The most conventional is a regional laboratory or university. However, several researchers in this study lived 30 to 50 miles from the laboratory to which they were assigned, and they felt more productive when they could do at least part of their work at home. (Especially given time and fuel costs of commuting.) Researchers might also want to go to another research group for a year or more, or even into a field setting. Neighborhood office centers, while an option for many organizations, are probably not very practical for energy researchers.

This project provides very little information about the ways in which computer conferencing might affect where people work. Apart from personal anecdotes from interviews, transcripts, or open-ended questionnaire responses, there is little data on this topic. Terminal location is perhaps the major determinant in where a person uses computer conferencing. Only a small number of participants had home terminals, and most lacked portable terminals which they could take from the office as needed. In fact, home terminals are sometimes seen as an unnecessary luxury. The preferred location is often a terminal room used by a group of people for varied tasks. We suspect that ease of access to computer terminals is a major factor in regular use of the medium. Thus, the lack of access to home or portable terminals in this study means that the question of whether computer conferencing could affect where people work was simply not examined, except by speculation or anecdotes from a few users.

The questionnaire did inquire about the frequency of working at home. Unfortunately, the question did not distinguish between working at home *instead* of the office and working at home *in addition to* a full office

schedule. Figure 7 illustrates the changes revealed by this question; and significant shifts did occur for the ERDA and low-usage groups. However, information from observations and interviews suggests that these changes were due to variations in the work load of the group--not to a simple effect of computer conferencing usage.

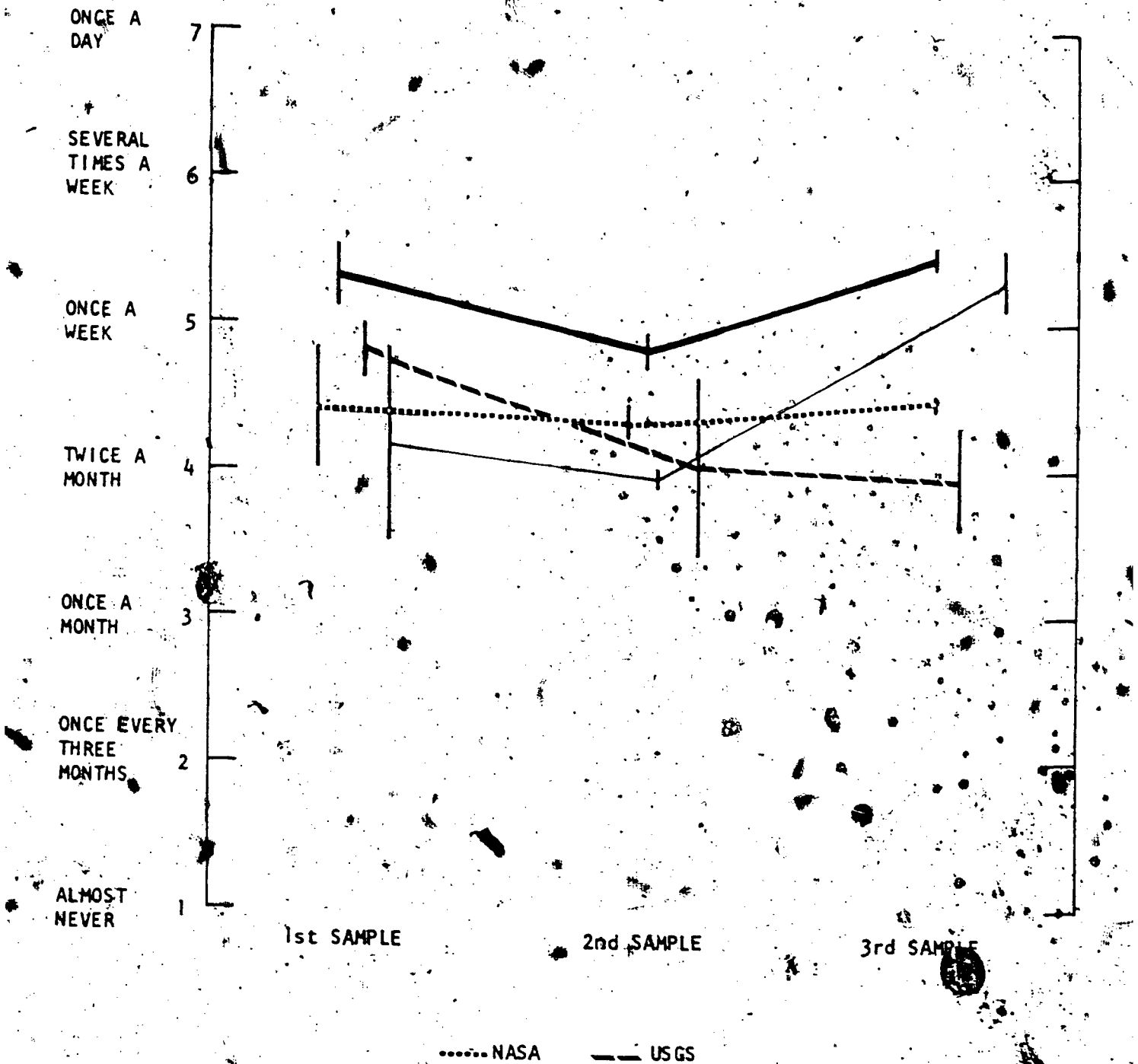
Interviews, questionnaires, and transcripts did offer some interesting insights about the applicability of computer conferencing to unusual work situations. For instance, a water crisis in the Washington, DC, suburbs caused the closing of two key installations at a critical point in one of the computer conferences. The major participant from this area simply moved his base of operations to his home (with a portable terminal), and the conference continued unimpeded. Another participant was hospitalized for a period of time; she was back in the computer conference before she could return to her office. Clearly, computer conferencing could add some flexibility to where people work and perhaps make them less dependent on a central office. However, the real potential for these effects remains largely unexplored.

The ERDA groups, for example, had established working patterns which involved working outside of normal office hours and working at home. Computer conferencing seemed to merely fit into this pattern and perhaps encourage its development to a small extent. The only real alteration in where people worked was with the Remote Office Group of USGS. In this case, discussed in Chapter II, a geologist moving to a rural area used PLANET as a major communications channel for continuing his work. However, these geologists used PLANET already; its availability was only one factor in the decision. Nevertheless, such a case does provide some guidance for further explorations in altering places where people work.

HOW PEOPLE WORK

In delineating this category of working patterns, we were interested in how energy researchers accomplish their daily activities. In particular, we are interested in their communication habits--how they tend to use, and mix, specific media. In reference to computer conferencing, we were

FIGURE 7. REPORTED FREQUENCY OF WORKING AT HOME



interested in whether the medium had (or might have) any measurable effects on current work procedures.

Our major sources of information about how study participants worked were the questionnaires and interviews, supplemented by the computer conference transcripts. These sources make clear that there is no simple relationship between computer conferencing and use of conventional communications media.* In some instances, however, participants felt that computer conferencing facilitated more production than would have been possible using conventional media (see Figure 8).

Use of the Mails.

Regarding mail, the assessment was nearly unanimous, and further discussion focused primarily on slowness and frequent unreliability of service. While the U.S. Postal Service is partly to blame, there was also mention of the sluggish internal paper handling which can plague large organizations such as ERDA. Letters can take several weeks to be typed, for example, and delivery within the organization is sometimes slow. For at least one of the ERDA groups, Express Mail (guaranteed overnight delivery) was used to exchange draft reports being discussed in the computer conference. Computer files were also used for exchanging these drafts, but Express Mail supplemented these exchanges when they were technically difficult. In specific instances where a quick written message was needed, computer conferencing was an advantage. It should be noted, however, that a computer mail system would often suffice, if group communication was not necessary.

Figure 9 displays the changes participants reported in frequency of exchanging letters with other researchers during the project. In most cases, the frequency of exchange went down during the period of computer conferencing usage. One might thus speculate that computer conferencing (or computer mail) could replace regular mail for research communication. Special

*Computer conferencing was only a small part of the work activities of most of these researchers. Thus, this study does not constitute a test of whether or not computer conferencing could replace many functions currently performed by other communications media.

FIGURE 8. RESPONSES TO A POST-USAGE OF PLANET QUESTION ABOUT RELATIONSHIPS TO MAIL, TELEPHONE, AND TRAVEL

QUESTION:

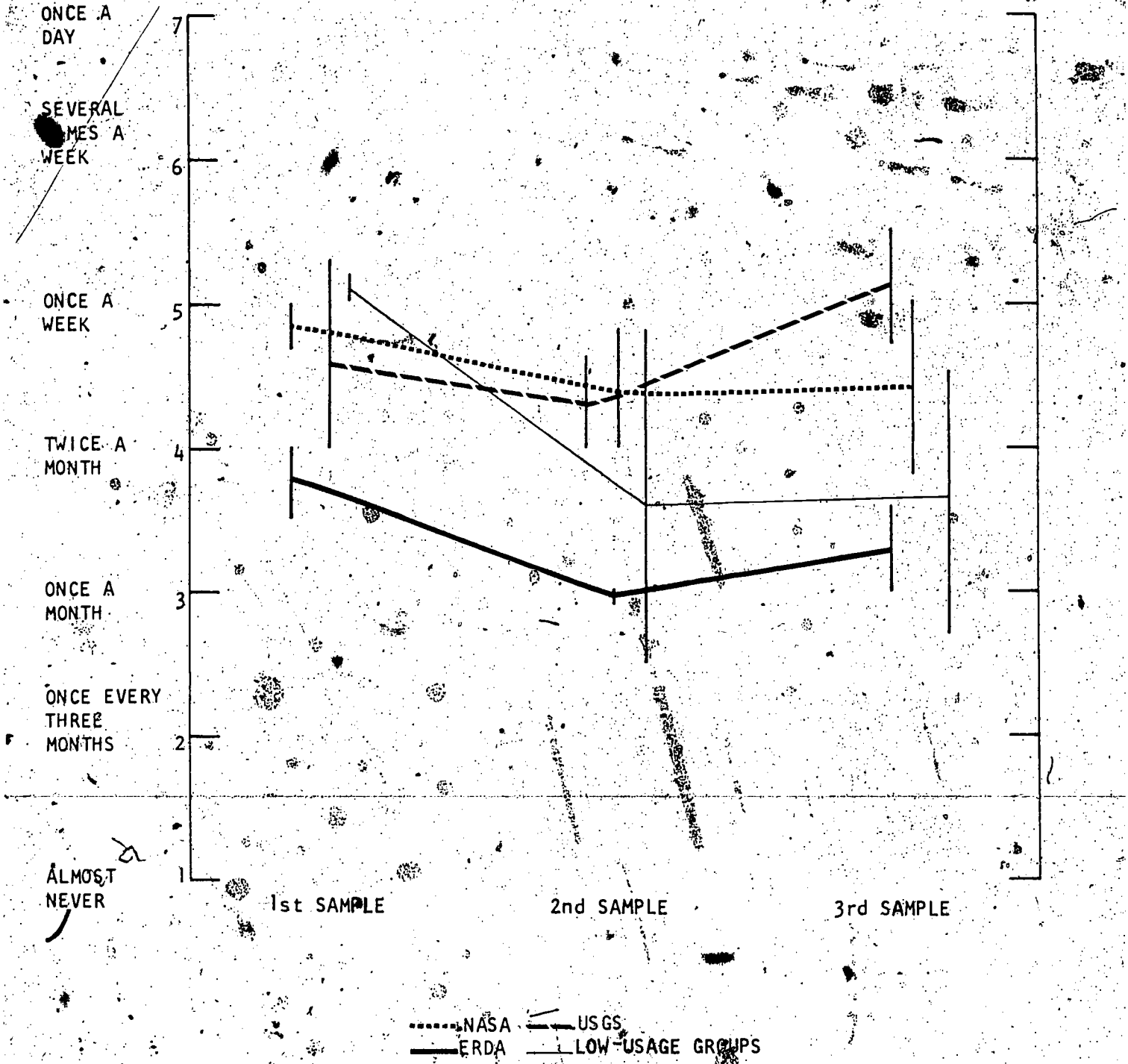
"Are there instances in which PLANET provided more productive communication than would have been possible using: . . . ?"*

	YES	NO
MAIL	87% (47)**	13% (7)
TELEPHONE	78% (43)	22% (12)
TRAVEL	54.5% (30)	45.5% (25)

*Asked on final questionnaire only.

**Number of respondents.

FIGURE 9. REPORTED FREQUENCY OF LETTER EXCHANGES WITH OTHER RESEARCHERS



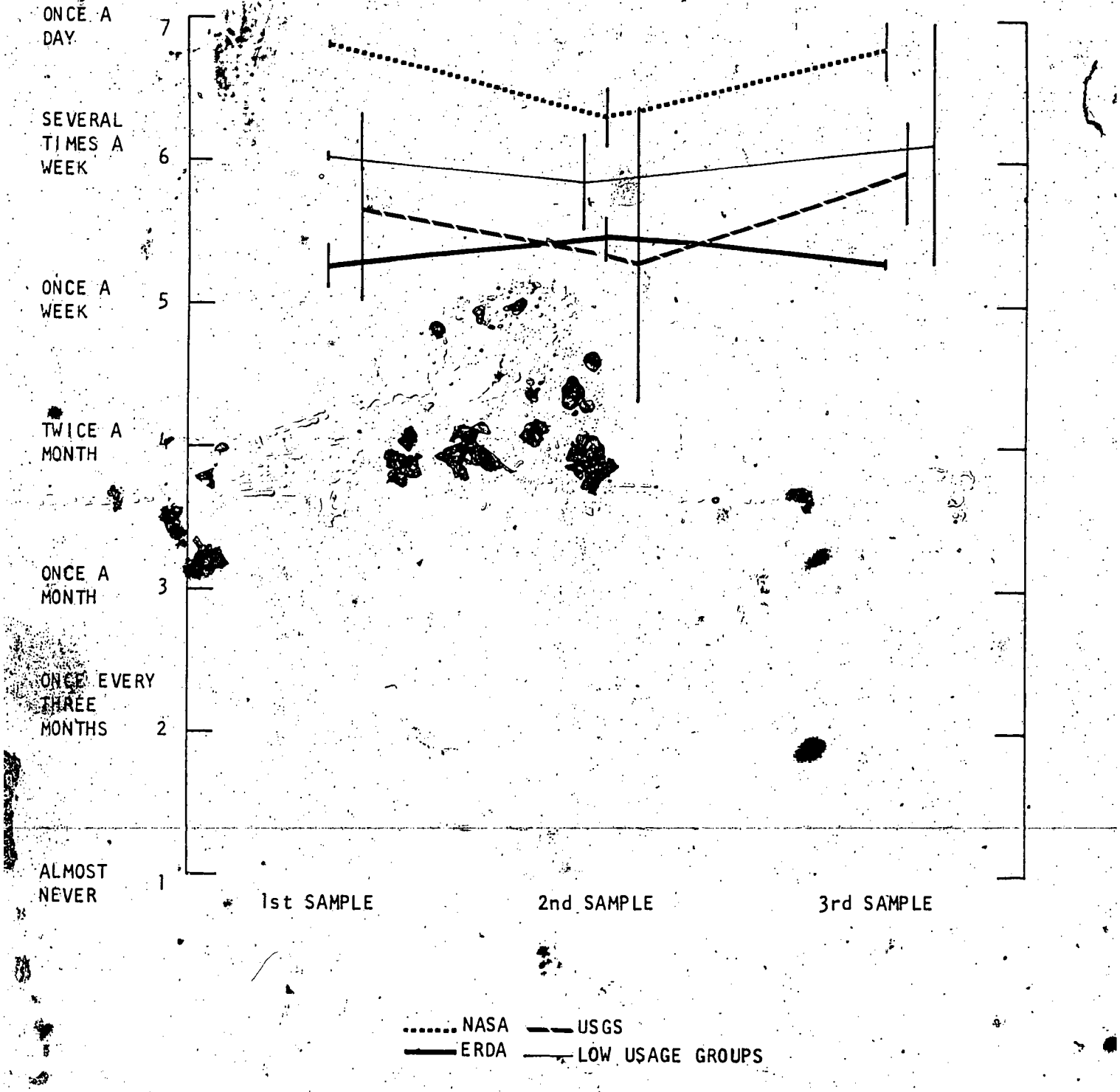
services such as Express Mail might still have useful functions, however. These questions will be explored in more detail in Chapter V on policy issues.

Use of the Telephone

Regarding telephone contact, the most frequently mentioned problem was finding other people in--especially with time zone differences and if groups of people were involved. Some respondents told of attempting to reach each other by phone for days without success, emphasizing that a computer conference message would probably be seen within a period of hours (*if* others were regular in their participation). The telephone is an interrupting medium with no sympathy for a researcher who doesn't want to be disturbed. Computer conferencing provides an opportunity for researchers to schedule uninterrupted work times while still being engaged in intense group communication with distantly-located colleagues. And, of course, the computer conferencing transcript provides distinct advantages (as well as potential disadvantages) in documenting exchanges between researchers.

The immediacy of the telephone does have real advantages and was used on some occasions to alleviate stress in computer conferences. One participant told us he frequently used the telephone to clarify important points or relieve tensions before they became harmful to the group. Private messages are sometimes adequate for this function, but the telephone is often more appropriate. Figure 10 shows the questionnaire responses on the frequency of telephone usage for communication with other researchers during the course of the project. No simple relationship is shown; telephone usage can either decrease or increase during periods of computer conference usage. It is interesting to note, though, that the largest increase comes from the low-usage groups, suggesting that the telephone may have substituted for at least some of the computer conferencing. It may also be, however, that a synergistic relationship can develop between computer conferencing and telephone usage--with increased telephone usage growing out of the adoption of computer conferencing.

FIGURE 10. REPORTED FREQUENCY OF TELEPHONE USAGE FOR COMMUNICATION WITH OTHER RESEARCHERS



Frequency of Travel

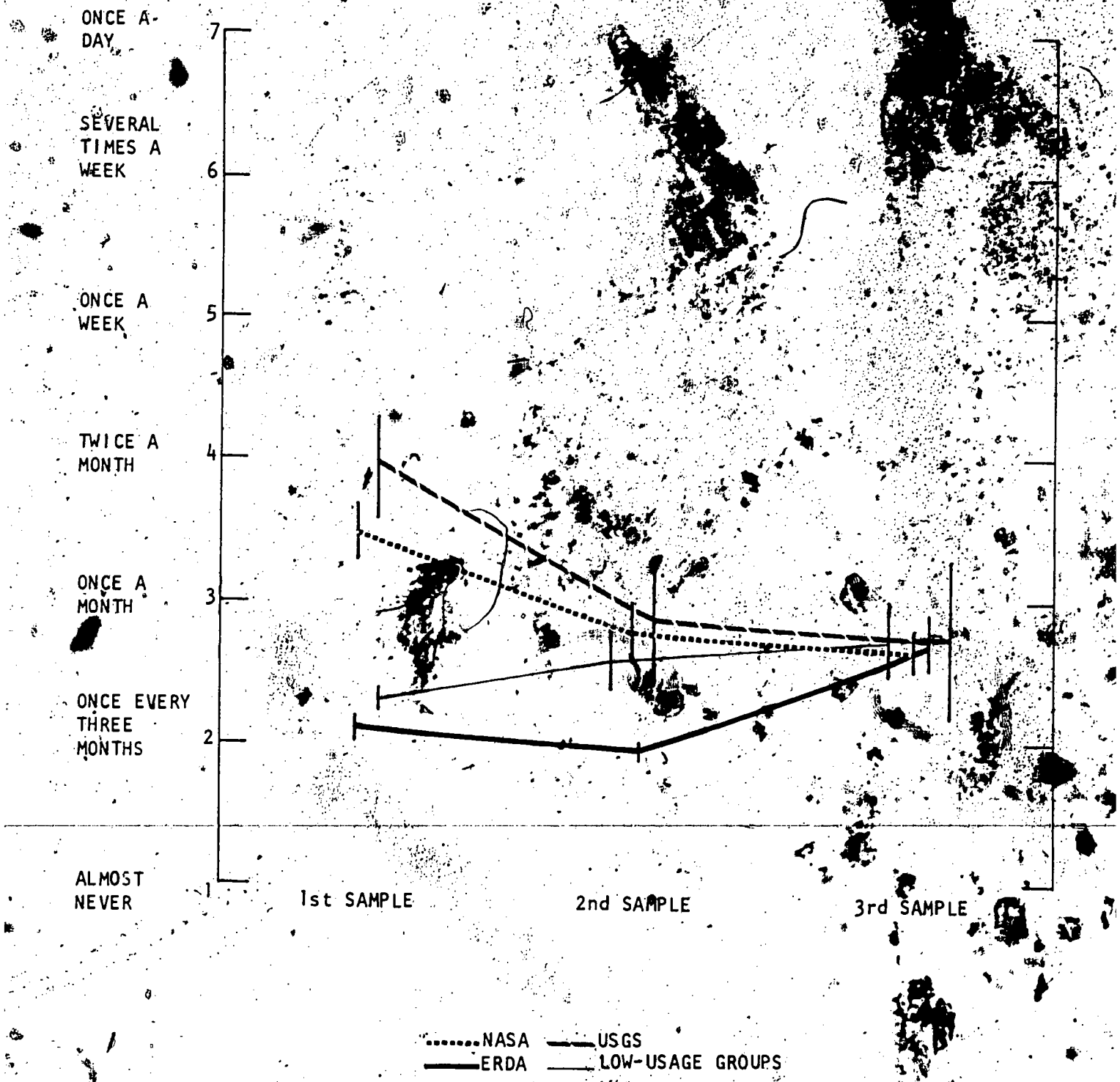
As Figure 8 shows, far fewer project participants felt that PLANET could provide them with more productive communication than a face-to-face meeting. Those that did see the potential emphasized that many face-to-face meetings probably need not take place--or at least not as frequently. Many researchers in this study already travel more than they would like. For those who are beyond this threshold, a medium such as computer conferencing could provide a more continuous link than face-to-face, without the complications of travel. However, for those who are not overburdened by travel and, in fact, enjoy it, there will not be much incentive for change. Of course, travel restrictions have already had some effect on these attitudes and are likely to be more important in the future.

Figure 11 summarizes the questionnaire responses about frequency of travel for discussions with other researchers. The NASA and USGS groups both show some decrease in travel during the usage period. In the case of the NASA group, face-to-face meetings were scheduled before PLANET usage began, and this reduction is probably most related to the completion of the CTS projects. Regarding the USGS groups, the reduction in travel may have more to do with problems of international travel for the GRASP group and the commitment of the Remote Office Group to experiment with *not* traveling.

Just as decreases in travel may be due to several factors, reasons behind an *increase* in trips are not always clear from the interviews or transcripts. It is possible that computer conferencing actually encourages an increase in travel, as new contacts are developed and working relationships evolve. One might speculate that researchers such as these have a rather constant ratio of communications to travel: as their communication increases through the use of computer conferencing, so their need to travel may increase.

During this project, computer conferencing was used effectively as a medium for planning and following up on face-to-face meetings. There is, however, evidence that simple *substitution* of communication for travel occurs and some evidence that travel may actually increase with the introduction of computer conferencing.

FIGURE 11. REPORTED FREQUENCY OF TRAVEL [illegible] FACE-TO-FACE MEETINGS FOR COMMUNICATION WITH OTHER RESEARCHERS



Time Devoted to Reading

The questionnaires also inquired about frequency of reading work-related literature. Figure 12 summarizes these responses during the project, and they are provocative. The indication is that when a significant change occurs, it is a reduction in reading. Perhaps the time that researchers spent using PLANET was time they might typically have spent reading. Or, phrased differently, the transcripts themselves may have taken so much time that they left little opportunity for reading. While such findings may have been related to outside factors, such as unusual time pressures, we did not find evidence of this.

How people work will, of course, be related to styles of computer conferencing which are chosen. Each style may have a different effect on how people work and, ultimately, what they work *on*. The energy research groups used PLANET for the following activities:

- Joint authorship of reports
- Information exchange among laboratories
- Scheduling joint projects
- Making arrangements and follow-ups for face-to-face meetings
- As a "bridge" to other computer resources (e.g., text editors, data bases)

A final questionnaire after the usage period provides more information on how the work of researchers such as these might be affected. The questions utilized a standard set of scales developed in Great Britain, called Description and Classification of Meetings (DACOM).* They asked respondents how satisfactory PLANET would be for a range of standard tasks. Figure 13 displays the overall results of the responses. The general finding is that PLANET is perceived as very satisfactory for tasks such as asking questions, giving or receiving information, giving or receiving orders, staying in touch, and exchanging opinions. However, it is not evaluated highly for

*Roger Pye, Brian Champness, Hugh Collins, and Stephen Connell, *The Description and Classification of Meetings*, Communications Studies Group, London, England, Paper P/73160/PY, 1973.

FIGURE 12. REPORTED FREQUENCY OF READING WORK-RELATED ARTICLES AND BOOKS

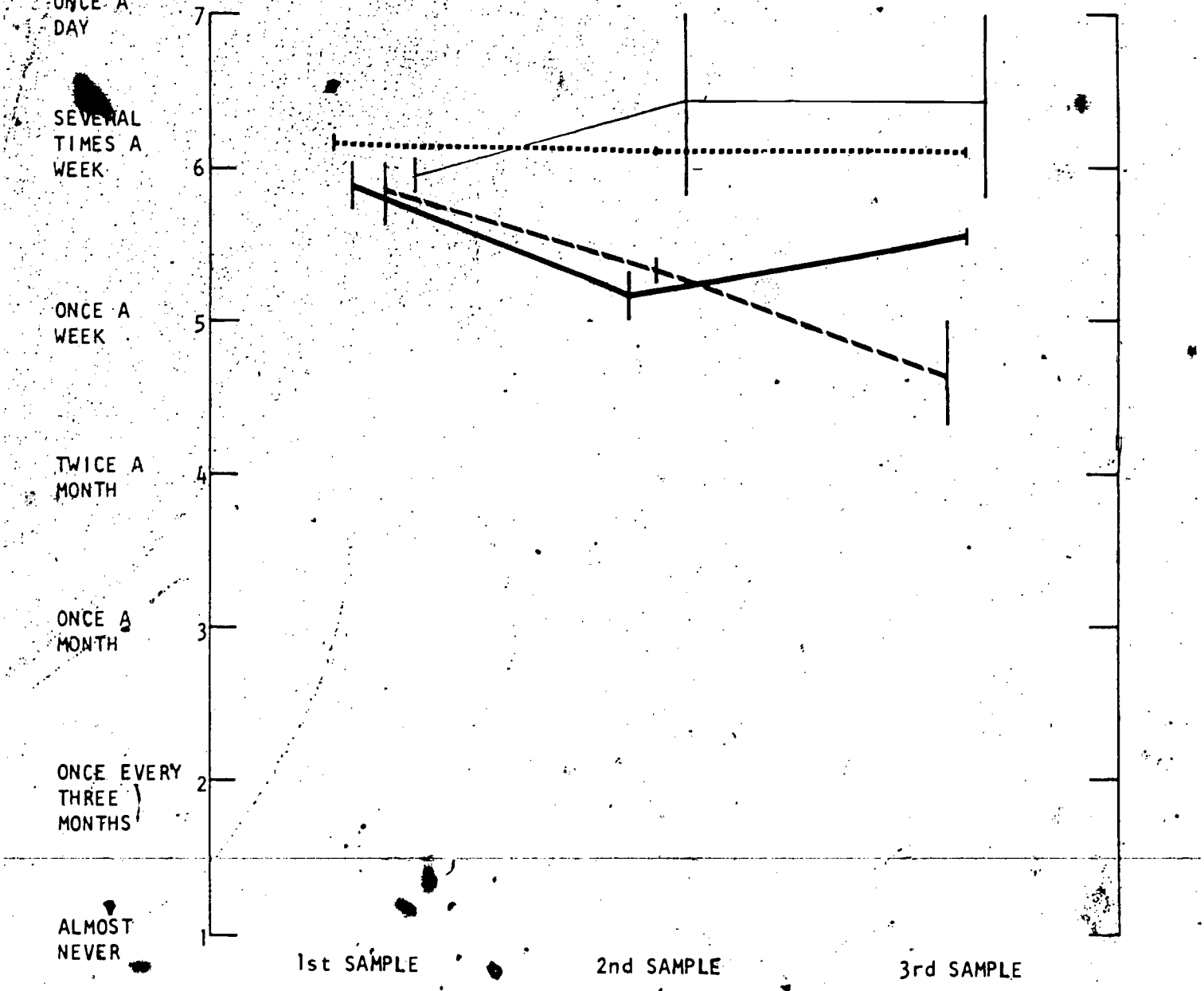
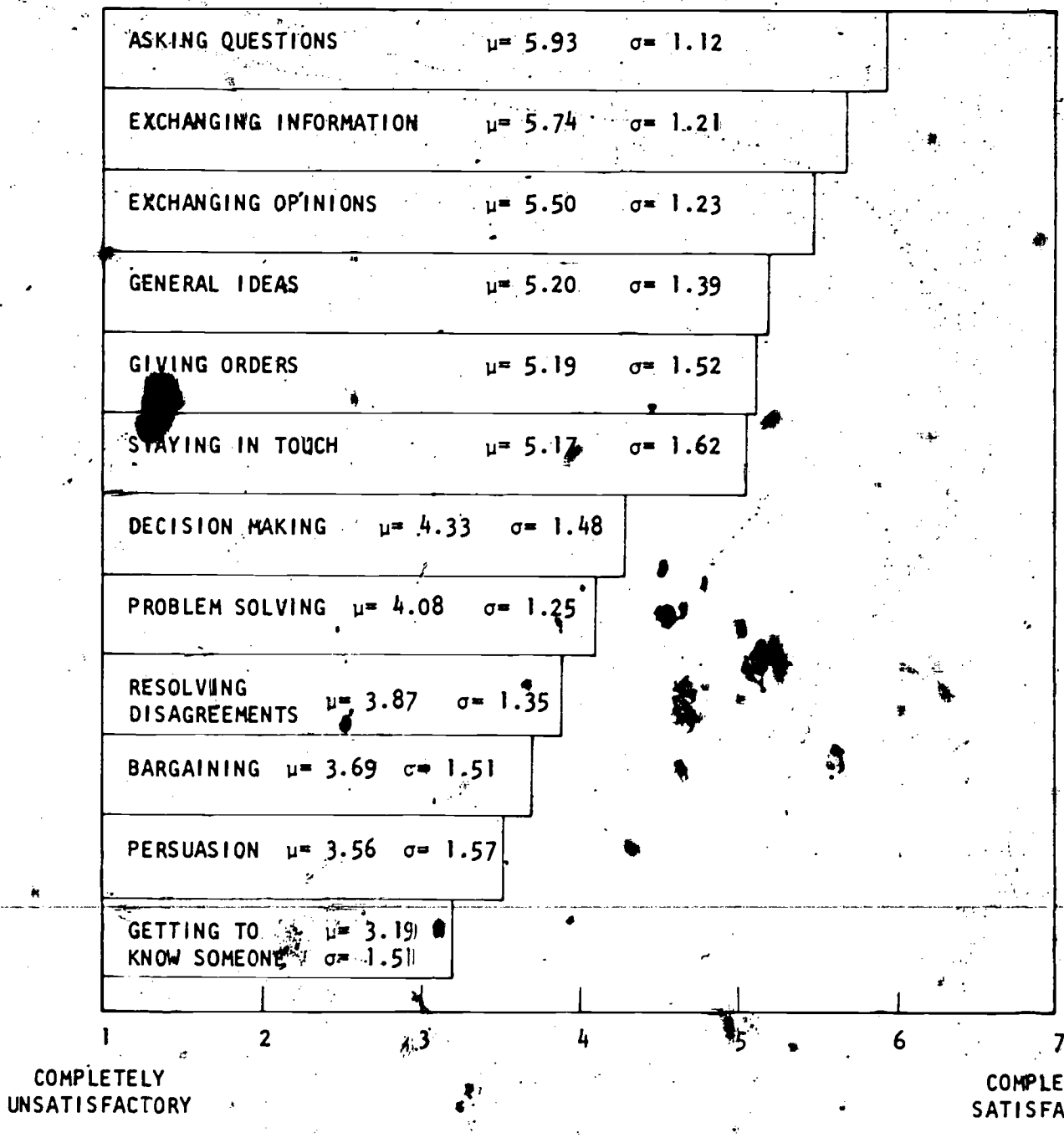


FIGURE 13. MEAN RESPONSES (AND STANDARD DEVIATIONS) TO THE DESCRIPTION AND CLASSIFICATION OF MEETING (DACOM) SCALES, ADMINISTERED AFTER USAGE OF PLANET



Number of Respondents = 57

μ= Mean
σ= Standard Deviation

getting to know someone, resolving disagreements, persuasion, or bargaining.* Of course, participants might become comfortable with the medium for tasks requiring more subtlety and sensitivity, but it seems that the less complicated aspects of their work are likely to be perceived as most appropriate for computer conferencing.

While participants apparently preferred computer conferencing for straightforward tasks, the transcripts indicate some intangible effects on their interaction which could be attributable to the medium. For instance, a key participant in one of the conferences entered a draft document for which he wanted reactions--but only certain types of reactions. He made the following entry in the conference:

> I suggest you not call me; however, I will periodically log into PLANET through the weekend until the afternoon of April 13.

It is clear that he wanted to respond to all interpretations of the draft report via a group medium. Rather than receiving a series of separate phone calls, he wanted to centralize this process and open discussion within the whole group. (Of course, private messages could also have been used for reactions.)

Extrapolating from the above example, we see that computer conferencing could affect how a researcher works. A significant portion of effort could be shifted to this medium, encouraging greater cooperation between researchers. But such an alteration would require a definite change in work habits. As one researcher put it on a questionnaire, "using PLANET more would require a reduction in other activities." And there are costs associated with such a change, not all of which are easily measurable. The leader of one of these groups made the following comment on one of his questionnaires:

---

*These findings are consistent with those from other computer conferencing users; see Jacques Vallee et al., *Group Communication Through Computers, Volume 4*. Also, the findings are remarkably similar to those obtained for audio and video teleconferencing. See Roger Pye and Ederyn Williams, "Is Video Valuable or Is Audio Adequate?," *Telecommunications Policy*, June 1977. A discussion of this similarity and its implications is contained in Jacques Vallee et al., *Group Communication Through Computers, Volume 4: Social, Managerial, and Economic Issues*, Institute for the Future, 1977.

> There are significant psychological drawbacks which must be adapted to. One is driven by active teleconferencing. It can be very distracting because one is continually feeling a need to respond to questions by others. There is no such thing as "out of sight, out of mind."

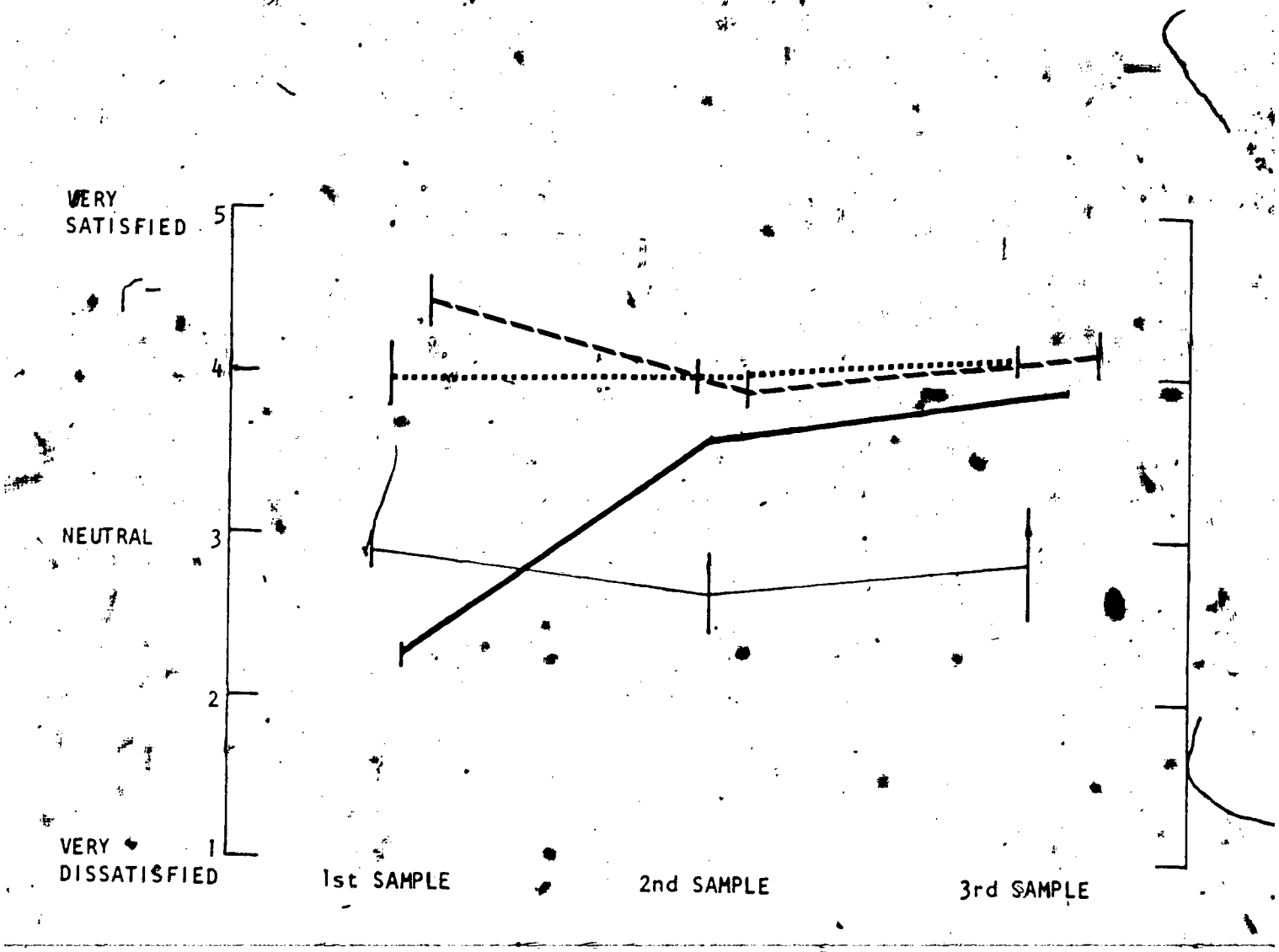
Computer conferencing does allow people to schedule their own participation times, but often there are overt and subtle costs. One might enter after several days' absence to find a hundred new entries spewing forth. Or the more subtle pressures noted above could prove very taxing to certain individuals. Changes in the way people work which are attributable to computer conferencing are likely to come slowly--perhaps justifiably so.

OUTCOME MEASURES

Each questionnaire asked respondents to rate their overall satisfaction with group communication within their own groups as they used PLANET. Figure 14 summarizes those responses and Appendix G gives the data on statistical significance of the changes. The ERDA groups provide the most dramatic increase in satisfaction, though it seems to reach a plateau after the second questionnaire. This questionnaire constitutes a summary judgment about the overall outcome of the group communication during each period and, thus, should be taken as strong evidence that increases *can* occur. Assuming that the researchers were in the best position to assess group performance, this change is one of the most significant findings in the study.

The NASA and USGS groups do not show a significant increase in satisfaction but both start higher on the scale. (It should be remembered that both of these groups had been using PLANET for some time when they filled out their first questionnaire.) The significant decrease shown by the USGS groups during the first interval still leaves them strongly toward the satisfied end of the scale. The low-usage groups, however, show measurable decreases in satisfaction as their experience with PLANET continues. Some of the reasons for this reduction have already been discussed in Chapter II; this finding merely documents the problems noted earlier.

FIGURE 14. REPORTED SATISFACTION WITH COMMUNICATION AMONG GROUP MEMBERS WHO ARE DISTANTLY LOCATED



The kinds of end products which emerged from these computer conferences vary from the concrete to the abstract. A number of actual products emerged from the various groups:

- A catalog of new resources available at ERDA laboratories;
- A four-volume, jointly-authored report;
- An up-to-date mailing list;
- Numerous exchanges of materials (e.g., energy-related data bases) between laboratories;
- A published transcript of a three-week computer conference;
- Schedules for experiments on the Communications Technology Satellite;
- Complete plans for several face-to-face meetings.

Products such as these are difficult to associate *only* with the use of computer conferencing; there were always other factors involved. But it is clear that these end products resulted from the efforts of these groups, providing some insight into the utility of the communication which did occur.

There were also less concrete outcomes, described in interviews or on questionnaires. These outcomes were:

- Avoidance of duplication of effort, thus saving time, effort, and money;
- Easing transition periods when researchers were shifting locations or traveling;
- Providing more direct contact between system designers and system users (GRASP and BDMS);
- Providing more diverse contact for junior researchers;
- Correcting misinterpretations which had occurred in face-to-face or telephone conversations.

These outcomes are very difficult to measure or assign directly to computer conference usage. Rather, they are testimonials from participants in the study about the value of computer conferencing to them. They are examples of qualitative increases in productivity which were associated by some of the participants with their use of [illegible]NET.

Outcome measures--both abstract and concrete--were not the focus of this study. Rather, we have focused on the *process* aspects of computer conferencing and attempted to place the participants in a good position to evaluate the real and potential effects of computer conferencing, using working patterns as a "proxy" for productivity. Viewed in the context of the Chapter I literature review, the limited number of measurable effects documented by this study suggest interesting productivity implications. For instance, Pelz and Andrews (1966) found that increased colleague contact stimulated research performance. Assuming this linkage is accurate, increased contact with geographically dispersed and interdisciplinary researchers reported by this study indicates computer conferencing may encourage greater productivity. As a research communication medium, computer conferencing requires self-activation on the part of both information seekers and givers. Andrews (1960) suggests that purposefully originated contacts are more likely to be productive. Even though computer conferencing is definitely a medium where participants originate the contact, the use of computer conferencing by one person does not guarantee that others will also use it regularly. Thus, some purposefully initiated use of this medium might actually prove frustrating.

Zagona et al. (1966) found creative problem-solving occurred most frequently when a group was nonhomogeneous, cohesive, flexible, open, and had strong but sensitive leadership. The current study indicates computer conferencing supports nonhomogeneous groups, across geographic and disciplinary boundries; potentially offers flexibility; allows cohesiveness to develop; and, perhaps more than face-to-face meetings, requires strong leadership. While this was not a study of creative problem-solving, the similarity of findings suggests other productivity-encouraging characteristics of computer conferencing.

Allen's (1970) work, indicating a direct relationship between perceived accessibility of information channels and utilization of those channels, bears significant implications for computer conferencing. As is explored more thoroughly in Chapter 4, researchers must overcome important hurdles before computer conferencing effectively facilitates information exchange.

Hurdles include the psychological barriers to using keyboard devices as well as the more real problems of finding a terminal and paying for use. Assuming these initial barriers are overcome, computer conferencing could greatly increase accessibility to distantly located colleagues and information.

Finally, Andrews' and Farris' (1972) findings concerning the negative impact of time pressure could suggest problems concerning the use of computer conferencing. The reported decrease in reading work-related literature during the field tests indicates that new reading and typing demands on researchers may add increased pressures. The use of computer conferencing requires researchers to spend more time reading conference proceedings and typing new entries. It is possible by carrying out routine communication in written form, researchers may find that they are overusing their visual senses at the expense of less demanding but still productive verbal interaction.

While the field tests suffered from a lack of control groups, they did raise a number of issues which call for further discussion. The final two chapters of this report will pursue these findings in terms of their implications for the actual use of computer conferencing in similar environments (Chapter IV) and their policy implications (Chapter V).

IV. GUIDELINES FOR THE USE OF COMPUTER CONFERENCING BY GEOGRAPHICALLY SEPARATED RESEARCH GROUPS

"We finally got the mechanics of operating the system sorted out; then the need to communicate took precedence over the mechanics of doing so."

--A PLANET User

Chapter III of this report has shown that there are no easily predictable effects of computer conferencing; rather, there are potential effects which may or may not occur with a given group, depending on a number of factors. It is important that computer conferencing be viewed as but one possible choice among a range of media options (including face-to-face communication). For a given environment, one must then decide (1) whether or not computer conferencing is appropriate and (2) if it is chosen, how it can be used most effectively.

The organization of computer conferencing implies several critical components. Some relate to mechanics of the medium; others, to questions of motivating people to adapt to, learn, and participate in computer conferencing. Relatively little work to date has been devoted to documenting these organizational factors and their impact on the success or failure of computer conferences. This chapter responds to the resultant lack of pragmatic guidelines for computer conference organizers. It draws conclusions from the research presented earlier but synthesizes them in a format directed toward those who may have leadership roles in computer conferences.

Earlier Institute for the Future work has examined the role of a facilitator in introducing people to the medium.* Also, Zinn, Parnes, and

*See Jacques Vallee et al., *Group Communication Through Computers, Volume 3: Pragmatics and Dynamics*, pp. 68-82.

Hench at the University of Michigan have developed a general "checklist" to assist in deciding whether or not to use computer conferencing. (See Table 5.) These efforts have done more to identify relevant areas of concern, however, than to develop prescriptions for making effective use of the medium. The potential organizer of a computer conference must have some guidelines in making the decisions which are obviously critical in whether the communication effort will succeed or fail.

PREREQUISITIES: CHOOSING WHEN AND WHEN *NOT* TO USE COMPUTER CONFERENCING

Based on computer conferencing experience to date, it seems possible to infer (if tentatively) some prerequisites for successful usage of the medium. We have attempted to limit this set of requirements to the *basic* conditions underlying a successful computer conference. Thus, the list is shorter and, overall, more specific than the checklist in Table 5; some items, however, imply a combination or broader interpretation of its components. If *any* of the prerequisites described below are not met, the probability for successful communication declines dramatically. If all the conditions are fulfilled, a successful conference is more likely--but still not guaranteed.

Prerequisite 1. A Perceived Need to Communicate

In the field tests we have observed, this seemingly obvious prerequisite has often been ignored. Computer conferencing has two characteristics which intensify the importance of a need to communicate: (a) It is "self-activated," meaning participants must discipline themselves to participate. If the need to communicate is not perceived as important by each participant, computer conferencing is likely to go unused or, at least, be irregularly used. (b) It is a strange medium to most people. While novelty effects may raise initial interests, the medium must become integrated with participants' workstyles if it is to have an impact. If the perceived need to communicate is not high, the medium is likely to go. Several of the low-usage groups in this study realized that their need to communicate was simply not as high as it originally had seemed.

TABLE 5. CHECKLIST FOR THE USE OF [COMPUTER] CONFERENCING*

Characteristics of the group:

- Size
- Distribution (location)
- Background (points of view)
- Interest in communicating
- Value placed on a written product

Characteristics of the topic:

- Complexity
- Alternate approaches
- Adequacy of written communication
- Possibility of written outcomes
- Role of reference information
- Changing information

Resources and scheduling considerations:

- Access to conference computer
- Access to user terminals
- Frequency of participation (replacing meetings)
- Staff for technical assistance
- Deadline for reports
- Provisions for off-line activity (listings, indexes, etc.)

Incentives to use conferencing:

- Save travel cost
- Increase meeting efficiency
- Record conference progress (research, credit to contributers, etc.)
- Open meetings to wider "audience"
- Explore new means for education
- Develop new skills for interaction with colleagues
- Research new tools of decision-making

*Source: Karl L. Zinn, Robert Parnes, and Helen Hench, "Computer-Based Educational Communications at the University of Michigan," *Proceedings of the Association of Computer Machinery (ACM) National Conference*, Houston, Texas, October 20-22, 1976.

The prerequisite of a high perceived need to communicate implies at least a loosely-defined "group" of computer conference participants. Minimal levels of cohesiveness and cooperativeness are necessary. If professional egos are too large or too competitive, for instance, the need to communicate as a group could easily become unworkably low. Computer conferencing is perhaps more susceptible to such problems than is face-to-face communication.

Prerequisite 2: Accessibility to the Computer Conferencing System

By accessibility, we mean access to both efficient computer terminals and reliable computers. It seems evident from our field tests that casual access is critical to the effective use of computer conferencing, especially during the first stages. A participant who must walk down the hall and wait in line in a noisy terminal room is much less likely to contribute than one who has an office terminal. While the importance of casual access depends on the balance of other factors, such as the intensity of the need to communicate, accessibility is clearly critical for all but the most dedicated groups. Also, the *type* of terminal can be important to participants, especially those who are not computer experts. Many standard computer terminals are littered with enough computer jargon to bewilder all but the strong in spirit. Terminals are participants' most direct contact with the computer--and with other participants--and can strongly affect their attitudes about belonging to the conference. Accessibility to computer conferencing means accessibility via a convenient terminal with which users feel comfortable.

Accessibility also implies a dependable computer system. During the field tests in this study, for instance, the computer networks became heavily loaded at one point and greatly reduced response times. Users had to wait at their terminals for the computer to respond; seconds seem like hours at times like these. Participation dropped as frustration rose, with the leader of the conference struggling to remedy the situation. Such problems are not trivial; computer reliability is a necessary starting point for successful computer conferencing.

Finally, the computer conferencing software must be accessible (i.e., usable) to participants. Of course, accessibility will be defined

differently by groups with varied levels of computer expertise. The tension here is balancing simplicity with the computing power necessary for the computer resources desired by particular groups. And it is difficult for system designers to develop programs which are nonthreatening for the novice user but potentially powerful for the expert. Still, it is critical that the conferencing software itself be compatible with (i.e., accessible to) the particular participants involved. As Gerstberger and Allen (1968) suggest, those communications channels which are *perceived* as most accessible will often be used in favor of those which have a higher technical quality.

Prerequisite 3: Adequate Introduction to the Concept and Techniques of Computer Conferencing

Each new participant will have individual reactions to computer conferencing, based largely on previous experiences. A computer expert may see it as a form of computer mail or messaging. A computer novice may see it as a sort of high-speed, typewritten chain letter. Such varied reactions are understandable and should even be encouraged. But there are a few basic concepts which do need communicating to novice users, and we feel that understanding these concepts is a prerequisite to the use of this medium.

First, it must be understood that computer conferencing involves *group* communication *through* a computer. Thus, computer conferencing is fundamentally different from a person-to-person medium, though clearly many overlaps and similarities exist with media such as computer mail. Second, the notion of the computer "conference" is misleading, since a variety of other group communication formats are possible. Third, the specific techniques for using the computer conferencing system need to be communicated, and the new users need a place to "practice" the basic skills which are necessary. For our field tests, we designed a simple user's manual* to introduce new participants to the PLANET program. Also, we had one staff member who was skilled at giving introductory sessions. Typically, he would send a user's manual to a new participant and arrange a time for an introductory session.

*Available from the Institute for the Future on request.

Then, with an open telephone line in parallel, if possible, he would hold a brief synchronous conference with the person and answer any questions which arose.* Such human contact seems critical for the initial sessions, even for people with previous computer experience. (Often, however, computer experts would refuse such introductory sessions and simply learn on their own with the aid of the user's manual. For some people, this worked fine; for others, it resulted in confusions which continued over long periods of time and impeded progress of the group.)

Effective introduction for new users of computer conferencing is a difficult area and one which often receives far less emphasis than it should. We are not fully satisfied with our own approach, which has included an article written to provide a quick, nontechnical introduction,** as well as the user's manual and personal introductory session mentioned above. In other work at the Institute, we recently completed a tutorial exercise to allow novice users to "try out" various teleconferencing media and practice the more subtle skills of these forms of communication.*** Still, the processes through which people learn to use (and often do *not* learn to use) computer conferencing remain largely uncharted and certainly worthy of further study. Our work to date has at least highlighted the importance of the introductory stage as a prerequisite to effective use.

Prerequisite 4: Openness to Typing

This seemingly trivial prerequisite is nonetheless basic to the successful use of computer conferencing. While earlier research has indicated that expert typing skills are not required in order to use computer conferencing,**** the skilled typist obviously feels more at home with the medium.

---

*Examples of these introductory sessions are given in Jacques Vallee et al., *Group Communication Through Computers, Volume 3: Pragmatics and Dynamics*, and *Volume 4: Social, Managerial, and Economic Issues*.

**Jacques Vallee, Robert Johansen, and Kathleen Spangler, "Computer Conferencing: An Altered State of Communication?," *The Futurist*, June 1975; and reprinted in *People's Computers*, September-October 1977.

***The tutorial was not available during the current study. Information is now available through the Institute for the Future.

****See Jacques Vallee et al., *Group Communication Through Computers, Volume 4*.

Beyond the question of typing skills, however, is the issue of whether individuals are *willing* to type. In some environments, for instance, typing is perceived as a low-status activity. Also, there are environments where union regulations allow only certain classes of employees to use keyboard devices. Thus, the typing requirement may raise both subtle and overt issues which affect the workability and success of a computer conference.

Prerequisite 5: Minimal Conflicting Needs or Demands on Participants

This prerequisite embodies a whole category of possible impediments to successful computer conferencing. For instance, if a significant number of potential participants in a computer conference have both a strong desire and opportunity for traveling, it is doubtful that the new medium will be greeted enthusiastically. Conference organizers should keep in mind, however, that there are only rare occasions where computer conferencing should be introduced as a substitute for travel (i.e., when travel is either not possible or not desirable, and when the tasks to be performed are well-matched to the medium).

Other possible conflicts might include outside time demands on a significant number of the participants, security requirements that discourage the use of a print-based medium or the available computer, or inadequate support from key management personnel. There are an array of possible conflicting needs or demands which could profoundly affect the progress of a computer conference. A minimal number of such conflicts is a necessary prerequisite for the use of this medium.

Prerequisite 6: An "Advocate" within Each Key Organization

This final prerequisite is probably generalizable to most situations where an innovation is being introduced in an organization. In our experience with the field test groups, each organization which began using computer conferencing effectively had one clearly identifiable advocate who shepherded the groups through their transitionary periods. (The advocate was sometimes playing a "gatekeeper" role, dispensing information as defined by Allen (1970).) If no one adopted this role, it was likely that the

groups would not adopt the use of the new medium. The "advocate" seemed necessary for computer conferencing to be given an adequate test.

In some cases, the advocate was at a managerial level, with only limited involvement in the actual conferences. In other cases, the advocate was also a group leader. As was clear in our discussion of computer conferencing styles in Chapter II, strong leadership, at both organizational and group levels, is critical to the adoption--or even consideration--of computer conferencing in the context of a given organization.

TOOLS FOR THE COMPUTER CONFERENCE ORGANIZER

Assuming that the above prerequisites have been met adequately and that computer conferencing is chosen as a communications medium for a given situation, an organizer is still faced with a variety of challenges. Just as there are skills in organizing a face-to-face meeting, so there are skills in organizing a computer conference.

A number of tools are available to facilitate the work of a computer conference organizer. Some are external to the medium (e.g., telephone calls for invitations, mail for draft reports, face-to-face for follow-up discussions). Others, inherent in the medium, include potentials for synchronous conferencing and private messages and use of online questionnaires or voting. Synchronous conferencing has frequently been used by conference organizers as a way of introducing new participants to the medium and providing an increased sense of interaction. In these field tests, synchronous conferencing was also used in a "brainstorming" mode to generate many ideas and get them on the record. Such uses may become confusing to some participants, as they require a sometimes-disturbing form of "fast thinking," with several topics under discussion simultaneously. The most frequent usage of synchronous conferencing in these tests was person-to-person or small-group meetings, most of which were spontaneous. An organizer might, however, plan to be present several times each day early in the conference in the hope of "meeting" people and assisting in their participation. Private messages might also be used in this process to offer encouragement or answer questions.

Organizers typically make heavy use of both private messages and synchronous conferencing.

Questionnaire and voting options vary among computer conferencing systems. As mentioned briefly in Chapter II, PLANET offers the secret ballot and multiple choice or open-ended questions. The responses are tallied by the system and may be inserted (by the organizer or question-asker) into the conference proceedings. In these field tests, the questionnaire and voting options were used by organizers as a way of focusing the discussion and testing for consensus. But care needs to be taken that the participants not feel too constrained by this format. An organizer must be delicate in his or her use of questionnaires with a computer conference in order that the participants not feel this constraint; also, others may become enamored by the questionnaire option themselves, and the organizer needs to be careful that this does not happen. Open-ended questions are the least constraining and still encourage each participant to respond to key questions. (If questions are not asked formally, they can often become "lost" in the transcript and go unanswered:)

With more sophisticated groups, an organizer might use other computer resources to enhance the performance of the conferencing group. For instance, one of the ERDA groups in this study used a text editor and a spelling correction program in editing a report being jointly authored. As appropriate, revised sections of the report could be directly inserted into the conference proceedings. In this way, computer conferencing can serve as a bridge to other computer resources--even if some of the participants do not have all the skills necessary to use the specialized services.

At a more subtle level, an organizer must also make group-process decisions frequently during the life of a conference. Periodically, it may be useful to synthesize previous entries to provide a summary statement of the current position of the group. Such summary statements can be very helpful in focusing a long discussion with many entries. The organizer may also want to divide participants into subgroups on more specific topics or invite outside resource people to participate at a key point. The decisions as to exactly *when* to suggest any of these options will be more art than

science, but it is important for organizers to have a good understanding of the range of structural options which is open to him or her.

In organizing some computer conferences, it will be possible to distinguish between the leader and the facilitator. It may even be that two separate people perform these functions. In such cases, the leader is likely to provide substantive guidance and focus, while the facilitator provides both "lubrication" and "glue" for the group. Both of these functions are significant. Whether or not they are performed by the same person, they are really specific components of the conference organizer's role.

The approaches taken by the organizer--and, therefore, the time and energy required--are likely to vary depending on the style of computer conferencing involved. Using the designations discussed in Chapter II, the "exchange" and the "community" styles both require long-term involvement for a period of months. However, the leadership requirement is not very demanding, assuming the commitment of the participants is high enough to insure regular participation. With a "seminar"-style conference, the organizer will need to play a very visible role (or assign someone else to do this). The "seminar" needs a high topic focus and high participation rates. And these needs would be even more pressing in an "assembly." Thus, while the basic tools of the computer conference organizer are constant from style to style, the approach and necessary commitment of time and energy vary considerably.

THINGS WHICH COULD GO WRONG

Even if all the prerequisites are met and the organizer does a conscientious and effective job, there are a number of things which could go wrong. (Just as in the case of a face-to-face meeting, even the best planning can go awry.) For instance, it is typical for some participants--often organizers--to become frustrated over a lack of response from other participants. In a computer conference, there is no equivalent to a nodding head or a reassuring smile. Often, participants say something to themselves as they read an entry by another but never give any formal response. This

lack of interpersonal feedback can be very frustrating and destructive in a computer conference. An organizer can respond to this situation by frequent use of private messages or even telephone calls. Keeping a "pulse" on such possible frustrations--especially among new users--is an important function of the organizer.

Irregular participation is another frequent pitfall, and it was especially evident among the groups of researchers in the present study. As mentioned in Chapter II, there are certain people who--by virtue of their own communications style--are more likely than others to cause such problems. Organizers often suggest a minimum frequency of participation as a guideline, and this approach proves very useful. However, it may still be necessary to prod some participants further. While the problem may seem to be one of self-discipline, it may simply reveal doubts that a participant had about the purpose of the meeting in the first place. Those who participate frequently will become increasingly frustrated as others fall further behind. Once such a situation develops, it can easily get out of hand, with some participants getting so far behind that they have no hope of catching up. The conference organizer must keep constant readings on the participation of the various group members.

A frequent mistake in computer conferencing is providing too much structure too early. An organizer might clearly picture the various parts of the discussion in his own mind, but his or her logic may not be consistent with that of the other participants. Thus, people could easily be saying the wrong thing in the wrong section of the conference, or new topics could be introduced which do not conform to the structure. Lengthy questionnaires are also a frequent reflection of overstructure problems. The best advice seems to be to start with minimal amounts of structure and allow the various parts to evolve as the group becomes comfortable with the medium.

A final computer conferencing pitfall to be noted involves the basic question of deciding when the conference is over. Of course, this is not a problem if a goal is clearly defined and that goal is reached. However, such a situation was not typical in the current study. More often, communication continued beyond logical concluding points and gradually tapered

off as people dropped out. Several organizers, however, specified dates on which the conference would end or, at least, be reassessed. Such an approach seems very wise, even in "exchange" or "community"-style conferences which go on for long periods. A group needs to periodically refocus its efforts, and in computer conferencing there is no clear breaking point; it is up to the organizer to make one.

IN SUMMARY

This chapter has placed more emphasis on the potential problems of organizing computer conferences than on the benefits. It is too easy to focus on the strengths of a new medium without a practical assessment of the problems of actually *using* it. We want to present computer conferencing--with its own characteristics and organizational requirements--in the context of other available communications media. Like other communications media, it cannot be evaluated without close examination of the ways in which it can be used. The effects noted in Chapter III are the results of the use of computer conferencing by the groups involved in this study. This chapter has presented ways in which future users can learn from current experience and develop their own approaches to effective communications via this medium.

CHAPTER V. SOME POLICY ISSUES RAISED BY COMPUTER CONFERENCING

It is difficult to forecast policy issues related to the use of computer conferencing in research environments. The effects of computer conferencing on working patterns--and certainly on productivity--are uncertain and obviously affected by a complex mix of factors which surround the medium's use. Still, the current study has suggested some significant policy implications of using computer conferencing with research groups. They arise from two related effects of the medium which became clear during the study: Computer conferencing (1) provides a new medium of communication with its own unique characteristics, thus widening the range of communications options open to participants; and, in so doing, it (2) reopens previous decisions about the entire structure of communication activities within an organization. Typically, "decisions" about communications are implicit in the administrative and geographical and, more subtly, the hierarchical structure of an organization. But a new communications medium such as computer conferencing introduces a new range of options and, in the process, raises basic questions about the current organization of communications. The resultant impact on working patterns suggests a number of policy issues which may accompany the introduction of computer conferencing into research environments.

Many of the policy issues identified here depend upon expanding usage of computer-based communication. Since computer conferencing is a subset of computer-based telecommunication services, increased computer conferencing use is linked to advances in other telecommunications services. For example, while present demand for computer mail services is greater than demand for computer conferencing, computer mail may create demand for group communication. Implementation of computer mail services facilitates use of computer conferencing by developing an infrastructure of computer networks and terminal access. Yet even if computer conferencing never becomes widely used, a number of effects we identify in this study might result from applications of computer mail.

We have used the variables examined in this study--when people work, how they work, where they work, and with whom they work--as a scaffolding to identify and clarify these issues. They are presented below, beginning with those most closely linked with the specific characteristics of computer conferencing and moving to those which arise from a broader consideration of the medium's impact.

- Computer conferencing is difficult to classify as either "computing" or "communications," raising basic issues about where it fits within regulatory and organizational structures.

Since Congress enacted the Communication Act of 1934, the telecommunications industry in the United States has been heavily regulated. In the early 1970s, when it became apparent that the convergence of communications and data processing technologies raised serious regulatory issues, the Federal Communications Commission (FCC) ruled that regulated common carriers (such as AT&T) could not offer data processing services (except through separate subsidiaries), and "hybrid services" (such as computer networks) would not be regulated unless they were essentially communications-oriented.* The FCC relies on this dichotomy between communication and data processing functions to define the scope of their regulatory duties.

Computer conferencing raises questions about the FCC's technical distinction between regulated and nonregulated services by offering communications through computer networks primarily dedicated to data processing functions. An American Federation of Information Processing Societies (AFIPS) conference in November of 1976 found that since computing involves communication and computers are an integral part of the telecommunications network, no meaningful technical boundry could be drawn between data processing and communication. The AFIPS conference suggested the FCC define "regulation" by policy decision rather than by an outmoded technical distinction.**

---

*Philip S. Nyborg, "Computer Technology and U.S. Communications Law," *Telecommunications Policy*, December 1977, pp. 374-5.

**Ibid., p. 377.

Unless the FCC acts on recommendations of those who advocate new telecommunications policy, the evolution and expansion of computer conferencing-like services could be severely limited.

Further definitional problems arise when computer conferencing is used across national borders. Computer networks, as in Britain, are typically not approved for carrying communications services. Thus, the use of computer conferencing is technically illegal in certain countries. Such problems will need to be resolved before large-scale international usage can develop.

Current organizational budget categories, as well as regulations, often do not match well with the characteristics of computer conferencing. For example, several of the field test groups had difficulty obtaining authorization to pay for their use of computer conferencing--not because it was too expensive but because it did not fit established budget categories.* It was even difficult, in some cases, to take funds from travel budgets for computer conferencing.

- Computer conferencing, as part of larger developments in computer-based communication, could contribute to higher mail costs.

As was explored in Chapter III, computer conferencing offers communications options not available through mail and telephone service. Yet clearly, telecommunications advances most affect mail service.

A Canadian Post Office study has estimated that 45 percent of first class mail begins and 20 percent ends up in a computer.** Much regular business and group communication could easily be carried out through computer networks. If a substantial portion of written communication finds its way into a computer network, mail could be limited to books, magazines, advertising, and parcels (some books, magazines, and advertising might eventually

*In one case, funds eventually came from the "computing" budget, but even this proved difficult because PLANET was not mounted on one of the usual computers used by the organization. Thus, further approval was needed for the particular computer to be used.

**Ithiel de Sola Pool, "Policy Choices for the Information Age," in *Refocusing Government Communication Policy*, Aspen Institute for Humanistic Studies, Washington, DC, 1976, p. 4.

be transmitted through computer networks as well). However, the value of voice communication in clarifying written documents will not erode as easily. Also, the Postal Service and its infrastructure risk massive losses of volume due to telecommunications advances, while major common carriers like AT&T and Western Union will not be drastically affected by greater computer-based communication because their underlying systems are used for the computer networks.

Loss in mail volume could further decrease access to communications channels. While capital costs of equipment will limit teleconferencing usage, higher mail rates due to decreased volume might price many small businesses out of an important communications service. For the whole society, increasing communications costs could widen the gap between the information-rich and the information-poor.

- The cost of computer conferencing could raise questions about who will be able to use it.

This study did not perform detailed analyses of the actual costs of computer-conference usage. It is clear from experience and previous work, however, that the costs of this medium--at least for the near future--will be substantial.* For our test groups, the costs ranged from $12 to $25 per terminal hour of usage, with the range due to varied accounting structures. With most groups a single source of funding was arranged; only the NASA group billed individual participants for their usage. Most participants were, then, subsidized for these usage time costs.

A reasonably expensive medium could imply, or actually create, a kind of exclusivity in certain environments, especially if costs are borne by a private person or group. Since computer terminals are necessary, in addition to computer time, there are definite fixed costs for gaining access to the medium.**

---

*Detailed breakdowns of the economics of PLANET usage on commercial computer networks is contained in Jacques Vallee et al., *Group Communication Through Computers, Volume 4: Social, Managerial, and Economic Issues,* Institute for the Future, 1978.

**The cost of terminals may, of course, go down dramatically. Also, it is important to consider the cost of alternative communications media to decide if computer conferencing is really "expensive" compared to other vehicles for group communication.

In organizations, the person who pays for computer terminals and time could control access to the medium. Furthermore, if participants owe their presence in the conference to the organizer or a funding officer to whom he reports, they may feel limited in the types of contributions they can make. While the costs of computer conferencing may drop sufficiently to discount this potential policy issue, such a drop seems unlikely at this time.

- The recorded nature of computer conferencing, specifically the written transcript of proceedings and the existence of usage statistics, imply serious potentials for the violation of personal privacy.

Computer conferencing is a print-based medium, with the text stored on a computer in machine-readable form. As was clear earlier in this report, there are distinct advantages to having a continuous written record of conference proceedings. However, this same characteristic provides the opportunity to take statements out of context or "read between the lines." For instance, a joke or a series of social exchanges in a computer conference may be very important in maintaining the vitality of a group (as they often are in face-to-face meetings), but they could be made to appear wasteful or childish if quoted out of context. Such exchanges, of course, happen constantly in human communication, but in a computer conference, they are more available to be scrutinized and misinterpreted.

Also, the ability to collect usage statistics on computer conference sessions poses real potential for misuse and even violations of privacy. For instance, use of participation statistics as a personal performance indicator, while it may be valid to a limited extent, can lead to serious misinterpretations about a researcher's productivity. Another area of possible misuse concerns the private message feature. Both the level of private exchanges and the identity of persons exchanging them can be tracked. Such statistics can be gathered very easily during computer conference sessions, and users need not even know they are being kept. Especially in times when officials may be grasping for *any* numbers which seem related to productivity, the record provided by computer conferencing could easily be manipulated and misused.

- There is no evidence to date that computer conferencing necessarily leads to broadened participation in group meetings. Specific policies will be needed to encourage a diversity of participation.

Computer conferencing makes it possible for geographically dispersed persons to form working groups. This implies greater potential for diversity of input and participation by researchers from smaller, more remote institutions. Furthermore, the exclusiveness of "invisible colleges" of researchers might be diffused to allow broader participation.* It is *also* possible, however, that electronic invisible colleges will be just as exclusive as nonelectronic ones; invitations to join a particular computer conference group could become as prized as positions at prestigious institutions. Therefore, while it might be theoretically possible to have diverse participation as a function of computer conferencing, a social structure which encourages such diversity will need to be developed.

Broad participation is not inherent in computer conferencing, although it may be allowed by it. For example, while computer conferencing provides the potential for regular contact among geographically dispersed researchers, there are obviously limits to the number of people who can work together in a given conference group. Thus, the technology of the medium opens an opportunity for redefining the criteria for selection of working group members, but it does not automatically assure diversity. Policy decisions must follow for this purpose.

Before explicit policies toward the use of computer conferencing are developed, it seems likely that the medium will be used effectively by some individuals to bypass *existing* group membership channels. For instance, junior researchers could gain status very quickly by building a network of national or international colleagues not normally accessible to junior staff. Such individuals might also have easier access to superiors through computer conferencing than through the normal channels of secretarial appointment-making.

---

*This argument has been made regarding computer conferencing already. See Starr Roxanne Hiltz and Murray Turoff, "Potential Impacts of Computer Conferencing Upon Managerial and Organizational Styles," submitted to *Interfaces*, 1976.

In summary, we have no evidence to date that computer conferencing *necessarily* leads to increased participation in group meetings or that existing decision-making hierarchies are likely to be challenged. While persons who are geographically separated can actively communicate via the medium, participation is limited by the needs for strong leadership and organization and apparent limits on the number of people who can actively participate. The diversity which is possible with the medium may be actualized only through policies formulated specifically for that purpose. In the meantime, the greatest opportunity for broadening contact among researchers may lie in the possibility for junior staff members to expand their communication network.

- Although computer conferencing allows *geographic* decentralization, it does not necessarily follow that *policymaking* structures will be more or less decentralized.

Computer conferencing can serve as a vehicle for raising questions about centralization versus decentralization. And the conclusions are not immediately evident. In allowing communication among remotely located persons, the medium clearly introduces a potential for decentralized working arrangements. It is likely, however, that the overall impact on organizational structures will not be pronounced and that the effects will only be felt at the level of individual researchers or small groups. Because the medium is only a tool for communication, it will most likely be used to pursue the stated goals of the organization which adopts it. It would need to be considered as part of a larger movement toward decentralization in order to have broad impact. And decentralization, while it may be the obvious effect of the medium, is not the only possibility. Computer conferencing could just as easily encourage greater *centralization* of authority and power within an organization. It might be used, for instance, to bind together the structure of an international organization. The participation and autonomy of remote offices of an organization could be severely limited or controlled through the use of media such as computer conferencing.

Policies regarding centralization and decentralization seem unlikely to be affected by computer conferencing if it remains at a scale easily

imagined for the near future. While the concept of computer conferencing has broad potential for reorganizing research communication, such a reorganization--if it occurs--will come about through a process of change in which the medium itself is only one among a number of tools.

- More flexible work arrangements raise questions regarding the supervision and evaluation of research activities.

Computer conferencing has some characteristics which could be useful in developing new supervisory procedures. For instance, computer conferencing can allow a manager to keep up with the activities of a number of groups without large time and travel expenditures. Although Mintzberg (1971) suggests that managers have inherent preferences for verbal over written media, several project managers used PLANET for administrative functions during these field tests. One took a "low-profile" approach by simply tracking the progress of several of his groups and occasionally making comments himself. He told us in an interview that this provided him with an informal idea of what was happening in the groups. (If he required formal reports, all he got was the formal--and less informative--positions.) Another manager took a stronger role and made specific requirements of the groups he was supervising. He used the medium in a more hierarchical way to give specific directions and make sure all the groups were up-to-date in their activities. It appears that both of these management approaches are possible using computer conferencing, and the choice may have most to do with the participants and the subject matter involved.

The flexibility of computer conferencing allows greater diversity of working hours and places than is currently the case in most research environments. This flexibility has several implications. "Office hours" could become redefined for many researchers, thus redefining the process of research supervision. Also, people may choose to communicate only during certain portions of the workday, while working without interruption during other periods. As Chapter I of this report stated, supervision of research activities is already a highly complex task with few adequate measures of performance. The widespread use of a medium such as computer conferencing could focus attention on how little is actually known about assessing

research productivity. Alternative measures relevant to such new media will need to be developed and validated.

The degree of control which a manager has over a researcher seems most likely to decline if computer conferencing is used extensively. A researcher could develop an active network of contacts outside his own organization and engage in communications of which his manager has little knowledge. Of course, managers could limit participation in such conferences or even secretly monitor what is happening. But such tactics would take considerable effort, as well as open the manager to a considerable amount of criticism.

- Computer conferencing could help reduce needless duplication of effort, if its use is encouraged by managerial and financial support.

The major use of computer conferencing during this project was as a medium for exchanging resources and avoiding needless (and unproductive) duplication of effort. The chief responsibility of those involved in the IWGDE group, for instance, was providing information and computer resources for projects underway at their respective laboratories. Discovering the existence of a needed data base or model at another laboratory could save months of labor, as well as providing the needed resources sooner. This type of exchange has obvious payoffs in terms of avoiding duplication and making the most efficient use of the resources which are available.

It is important to note, however, that the management of the IWGDE group played a key role in facilitating this resource exchange. Such management support is necessary if exchanges are to occur on a regular basis. Also, the organization of the IWGDE was based on the initiative of the participants and had very little financial support. While the exchange worked in this case, such high motivation will likely not be present in most groups. Therefore, policy decisions will be needed which recognize not only the potential of computer conferencing for information exchange but also the need for managerial and financial support of this function.

- The type of interorganizational and interlaboratory communication provided by computer conferencing could challenge current administrative structures for research funding, or even affect the independence of particular organizations.

Through their use of computer conferencing, the field test groups in this study evolved a number of alternative organizational forms which could prove challenging to the current administrative units in which they function. While such challenges did not develop during the study, the *potential* was clearly evident. In addition, the interorganization communication facilitated by computer conferencing raises another, broader question about potential long-term effects on the independence of research groups. These two issues are related but vary in the level of their impact.

The potential for regular working relationships among researchers at different institutions could challenge current institutional structures for allocation of research funds. For example, if a researcher's primary community becomes geographically separated, he or she may want to undertake more projects with this remote group. Existing laboratory structures may seem less logical if a greater number of one's day-to-day contacts are remote researchers. For example, alternative funding structures for the work of IWGDE were explored during our field test. However, this group was working in support of the organizational goals of ERDA and eventually found specific financial support. With many research groups, as with IWGDE, there will still be a number of interests tying remote researchers to their existing institutions.

The data exchange and information sharing described above represent one way in which computer conferencing may stimulate new interagency and interlaboratory working relationships. A potentially greater impact might be seen for groups which actually conduct a large segment of their research over computer conferencing systems. The most relevant example we had of such a group was Network Investigators, which actually produced a major report using PLANET. They too, however, used the system in an effort to better coordinate interlaboratory resource sharing--both computer networks and data acquisition. Thus, they were supporting, rather than challenging, existing

institutional structures in their efforts to carry out their work more efficiently. More highly developed electronic communities might challenge the current administrative structures, but the challenge will have to be well-organized in order to avoid simple rejection by the status quo. Institutional barriers could prove particularly strong toward an unconventional medium such as computer conferencing.

In addition to raising funding questions, the interagency and interlaboratory exchanges made possible by computer conferencing suggest the possibility of more serious implications for the independence of research groups. The current structure of the energy research environment, for example, is built around a number of separate research installations which sometimes exist in competition with each other. While coordination of research activities is desirable in order to reduce needless duplications, there are also strong arguments for actually encouraging a certain degree of separation of research efforts. An overemphasis on research exchanges can mean that all researchers may share the same biases, as well as the same insights. There will always be a need for assumption-questioners, and it can be argued that increased communications could have negative effects on the development of new ideas. Also, the *separation* of particular organizations could serve an important checks-and-balances function which it would be undesirable to circumvent. For instance, it was revealed recently that Nuclear Regulatory Commission officials considered influencing USGS researchers to lower their estimate of the potential seismic activity of an earthquake fault located near a nuclear power plant.* If computer conferencing begins to break down institutional barriers which currently help guard against such activity, these types of incidents might become more common. It is important to assure that computer conferencing, in encouraging information exchange, does not promote an undesirable overlapping of agency authority.

Los Angeles Times, June 29, 1977, p. 1.

- Computer conferencing raises questions about the structure of research communication, the nature of job descriptions, and decisions about location of employees.

Computer conferencing restructures both the way in which people communicate with each other (see Chapter II on individual and group usage styles), as well as the opportunities they have to communicate. This restructuring has tangible implications in the possible substitution of one media for another and, on a broader level, suggesting that new communications activities will develop among researchers. There will be cases (e.g., simple information-exchange or question-asking) where a direct substitution of media will occur, while the communication process itself remains essentially unchanged. Broader impact will result from the new or changed opportunities for communication which computer conferencing provides. In the current study, for example, researchers at USGS and ERDA made new contacts and shared data bases previously unknown to them. For the IWGDE groups, an already existent communications link was redefined. Prior to their PLANET usage, the groups had been communicating through mail, telephone, and a few face-to-face meetings. With the introduction of computer conferencing, they evolved a style of daily contact which involved all the groups on a continuous basis.

The use of computer conferencing in an organization could affect the nature of particular jobs. It has even been suggested that some secretarial or clerical unions might resist any use of typewriter computer terminals by research or professional staff. Secretaries, then, would receive and transmit messages, serving as the direct participant in computer conferencing. This could create an interesting informal network of secretaries. The status associated with various media might also be shifted, with terminal usage having more prestige than use of a typewriter.

Finally, the possibility of substituting computer conferencing for a person's presence raises a number of issues about where researchers should be located. Decisions concerning the appropriate location for employees will become much less clear-cut if computer conferencing is available. Competition for positions could arise among regional offices, field stations, and agency headquarters. Also, a potential reduction in the need for liaison staff could raise volatile questions about equipment versus

manpower tradeoffs. Individual researchers may view computer conferencing as either a boon or a barrier, depending on whether they would like to move or remain settled where they are.

* * *

Policy issues regarding the role of computer conferencing vis-à-vis other media will reduce at some point to specific decisions about which medium to use when, as well as how--if at all--new media will be regulated. The criteria for decisions concerning all the policy questions raised in this chapter are currently uncertain; studies such as this one are providing preliminary insights and information. Policy decisions regarding use of computer conferencing will have direct effects on the future of specific organizations. Disorganized responses to new media could result in unnecessary constraints and missed opportunities.

APPENDIX A

DETERMINING EFFECTS: A NOTE ON STUDY STRUCTURE AND METHODOLOGY

This field test study of computer conferencing provides a basis for reconsidering the way in which such projects are organized and funded. The current study was organized by the Institute for the Future, funded by the National Science Foundation, and actually conducted within the Energy Research and Development Administration (as well as, to a lesser degree, NASA, USGS, and Kettering). In retrospect, this arrangement proved difficult and added to problems of organizing the field test. We now feel that it would be preferable for such field tests to be funded--at least in part--by the organizations in which the participants are involved. While we did require the participants to pay for their own use of computer conferencing, this was only an incentive for those who actually chose to use the medium. Those who did not use the medium had no reason to provide us with information about their own communication patterns or in any way serve as a "control" group. Also, it was difficult to get pre-computer conferencing information from groups; they often delayed their decisions on participation until after they had tried out PLANET. The resulting scarcity of data on communication patterns *before* computer conference usage began and about groups which did *not* choose to use computer conferencing are major limitations of this project which should be remedied in future studies.

Regarding design of the study, we now feel that more qualitative measurement approaches should also have been used in the project. In particular, observation techniques could have been used more extensively to better understand the organizational context in which these groups were operating. Such techniques could have provided more detail on actual usage styles for computer conferencing, since it is now clear that variations in usage are critical to the quality of the outcome. Leadership styles, learning effects, and other dynamic aspects of group communication through computers

could be much better understood through a stronger mix of qualitative, as well as quantitative, methods. Finally, concepts of research productivity more relevant to these particular test groups might also have been developed, rather than relying only on the current literature.

APPENDIX B

INITIAL AND POST-USAGE INTERVIEW SCHEDULES

INITIAL INTERVIEW (with at least one member of each interlaboratory group)

Open the interview something like this:

"Could we talk a bit about the general nature of the _____ group? What sort of work are you doing?

PROBES:

Are there olearly stated goals for the group?

How do you presently communicate with each other?

(As the person describes his work with the group, note examples of each task type as they occur. If some task types are not mentioned, ask whether these ever occur within the group.)

BASIC TASK TYPES:

GIVING OR RECEIVING INFORMATION

PROBLEM SOLVING

BARGAINING OR NEGOTIATION

DECISION-MAKING

GENERATING IDEAS

PERSUASION (getting others on one's side in an argument)

ASKING QUESTIONS

RESOLVING DISAGREEMENTS

GETTING TO KNOW SOMEONE (forming an impression of others)

GIVING OR RECEIVING ORDERS (delegating or accepting instructions)

MAINTAINING FRIENDLY RELATIONS (staying in touch; keeping people up to date)

EXCHANGING OPINIONS (discussion of ideas)

POST-USAGE INTERVIEW SCHEDULE

Purpose of the interview is to test our assumptions about the long-term effects participation in a computer conference has upon researchers' work styles.

1. In what ways has computer conferencing been especially helpful to you?

2. In what ways has it been a hindrance?

3. Do you think a successful computer conference depends upon a group's need to communicate? What role does regular usage play in a computer conference?

4. Can computer conferencing replace face-to-face meetings? Probes: Can it make them less necessary? More efficient?

5. Did computer conferencing reveal hidden dimensions in the group process? Did it highlight inadequacies of other media such as the phone and mail?

6. By using PLANET were you able to circumvent any bureaucratic road-blocks?

7. What type of people don't adapt to PLANET? Probes: Pressure-driven workers? People who can talk and think "on their feet"?

8. Did computer conferencing provide greater structure in your work? Probes: Did you have a better feeling for what needed to be accomplished? Did it help with: Planning? Coordinating? Organizing?

9. Did computer conferencing accelerate the sharing of information?

10. Did computer conferencing help maintain contact with distant colleagues? Probe: Personal relationships as well as working relationships?

11. Did responding to the input provided by computer conferencing put a greater demand upon your time?

APPENDIX C

TIME SERIES AND POST-USAGE QUESTIONNAIRES

from

to

Institute for the Future
2740 Sand Hill Road
Menlo Park, CA 94025

Question 1

How frequently do you do each of the following:

	Daily	Several times a week	About once a week	About twice a month	About once a month	About once every 3 months
a. Communicate* with researchers in your own organization (work related).....	(7)	(6)	(5)	(4)	(3)	(2)
b. Communicate with researchers in other organizations in your locality.....	___	___	___	___	___	___
c. Communicate with researchers in different regions of the United States..	___	___	___	___	___	___
d. Communicate with researchers in other countries.....	___	___	___	___	___	___
e. Communicate with researchers in other disciplines.....	___	___	___	___	___	___
f. Work at home.....	___	___	___	___	___	___
g. Work outside of normal office hours..	___	___	___	___	___	___
h. Read work-related articles and books.	___	___	___	___	___	___
i. Exchange letters with other researchers.....	___	___	___	___	___	___
j. Use the telephone to talk with other researchers.....	___	___	___	___	___	___
k. Travel for discussions with other researchers.....	___	___	___	___	___	___
l. Use method *other than* letters, telephone, or travel for communicating with other researchers (explain: _____).....	___	___	___	___	___	___

*By "communicate" we include such activities as face-to-face meetings (traveling when necessa
facsimile systems, etc.

The following questions refer to the group(s) with whom you have been using PLANET.

Question 2

In order to work more effectively, how frequently would you prefer to do each?

...hs	Less	Same	More

telephoning, mail, use of

Question 3

How satisfied are you with communication among group members who are distantly located?

Very Satisfied		Neutral		Very Dissatisfied
(5)	(4)	(3)	(2)	(1)

Question 4

What were key influences on communication patterns among distant members of this group over the last three months (e.g., factors related to communications media, group features, tasks)?

Question 5

In the last three months, can you think of instances in which specific media (e.g., telephone, mail, face-to-face meetings, PLANET) helped the progress of the group? Please describe:

Question 6

In the last three months, can you think of instances in which specific media hindered the progress of the group? Please describe:

Question 7

Are there any instances in which PLANET provided more productive communication than would have been possible using:

Conventional mail	yes ____	no ____
Telephone calls	yes ____	no ____
Travel (for face-to-face meetings)	yes ____	no ____

If yes, please explain:

Question 8

How has the use of PLANET affected <u>where</u> you work, <u>when</u> you work, <u>how</u> you work or with <u>whom</u> you work?

Question 9

How satisfactory do you think PLANET would be for the following activities?

	COMPLETELY UNSATISFACTORY						COMPLETELY SATISFACTORY
GIVING OR RECEIVING INFORMATION	—	—	—	—	—	—	—
PROBLEM SOLVING	—	—	—	—	—	—	—
BARGAINING	—	—	—	—	—	—	—
DECISION MAKING	—	—	—	—	—	—	—
GENERATING IDEAS	—	—	—	—	—	—	—
PERSUASION	—	—	—	—	—	—	—
ASKING QUESTIONS	—	—	—	—	—	—	—
RESOLVING DISAGREEMENTS	—	—	—	—	—	—	—
GETTING TO KNOW SOMEONE	—	—	—	—	—	—	—
GIVING OR RECEIVING ORDERS	—	—	—	—	—	—	—
MAINTAINING FRIENDLY RELATIONS ("STAYING IN TOUCH")	—	—	—	—	—	—	—
EXCHANGING OPINIONS	—	—	—	—	—	—	—
OTHER (What? . . . . . .)	—	—	—	—	—	—	—

Question 10

When you use PLANET, where is your computer terminal located? (e.g., down the hall in a computer terminal room, in your office, at home, etc.)

APPENDIX D

USAGE STATISTICS GATHERED DURING PLANET TELECONFERENCES

Variable Code	Abbr.	Full Name	Description
1	ACCOUNT	Account	Name of User Account
2	ACTIVITY	Activity	First three letters of activity name
3	PARTIC.	Participant	First three letters of Participant name
4	TOT.VRB.	Total Verbosity	Average number of words per message
5	PBL.VRB.	Public Verbosity	Average number of words per public message
6	PRV.VRB.	Private Verbosity	Average number of words per private message
7	PRC.TYP.	Percent Typing	The ratio of total time spent typing messages to total usage time expressed as a percentage
8	TYP.SPD.	Typing Speed	The average number of words typed per minute of typing time.
9	PRC.SYN.	Percent Synchronous	The ratio of synchronous time (when two or more participants are present in the activity at the same time) to the total usage time expressed as a percentage
10	PRC.PRV.	Percent Private messages	The ratio of private messages to total messages expressed as a percentage
11	% PRV.ALB.	Percent Private Albedo	The ratio of total private messages received to private messages sent and received expressed as a percentage. The [illegible] is 0 for pure "senders" and 100 for pure "receivers"
12	COST/HR.	Cost per Hour	Average cost per hour of usage
13	INFOTRN.	Information Transfer Rate	The number of words per minute sent and received by a participant in an activity.
14	INFODLAY	Information Delay Time	The average number of hours between the time public messages were sent in an activity and the time a participant received them, weighted by the length of the messages in words
15	TLMG/HR.	Total Messages per Hour	Average number of messages sent per hour
16	PBMG/HR.	Public Messages per Hour	Average number of public messages sent per hour
17	PRMG/HR.	Private Messages per Hour	Average number of private messages sent per hour

Variable Code	Abbr.	Full Name	Description
18	EDIT/HR.	Editing Characters per Hour	Average number of all editing used per hour of usage (includes totals for individual editing characters)
19	CMD/HR.	Commands per Hour	Average number of commands used per hour of usage (includes totals for individual commands)
20	PRV.MAP	Private Message Map	A matrix indicating the number and total length in words of private messages exchanged among the participants in an activity
21	SESSIONS	Sessions	The number of times a participant entered an activity
22	PBL.MSG.	Public Messages	Number of public messages sent
23	PBL.WDS.	Public Words	Number of words in public messages
24	PRV.MSG.	Private Messages	Number of private messages sent
25	PRV.WDS.	Private Words	Number of words in private messages
26	CTRL X	Control X	Number of messages cancelled before being sent
27	CTRL Q	Control Q	Number of lines of text cancelled in editing
28	CTRL W	Control W	Number of words deleted in editing
29	CTRL A	Control A	Number of characters deleted in editing
30	CTRL S	Control S	Number of times total message text is reprinted in editing
31	CTRL R	Control R	Number of times line of text is reprinted in editing
32	QUIT	Quit or Control C Command	Number of times Quit or control C command is used
33	REVIEW	Review Command	Number of times Review command is used
34	STATUS	Status Command	Number of times Status command is used
35	SAVE	Saving of Entries in File Command	Number of times Save command is used
36	SUBMIT	Submitting File Contents to Transcript command	Number of times Submit command is used
37	JOIN	Joining Other Conferences Command	Number of times Join Command is used
38	VOT.CMD.	Voting Commands	Number of times Ask or Feedback command is used.

Variable Code	Abbr.	Full Name	Description
39	ORG.CMD.	Organizer Commands	Number of times Delete, Add, Remove or Erase command is used
40	ADD	Add Participant Command	Number of times Add command is used
41	CTRL P	To Planet Command	Number of private messages sent to Planet
42	QST.MRK.	Question Mark Command	Number of times Question Mark command is used
43	DELETE	Delete Entries Command	Number of times Delete command is used
44	REMOVE	Remove Participant Command	Number of times Remove command is used
45	TRM.TYPE	Terminal Type	The terminal types are: 0 paper printing, 1 Hazeltine 2000, 3 Tektronix 4023, 3 Datapoint 3300, 4 Beehive, 5 Superbee, and 6 other CRT terminals
46	ASK ESY.	Ask Essay Question	Number of questions used requiring an essay response
47	ASK VOTE	Ask Vote Question	Number of questions used requiring a Vote response
48	ASK NUM.	Ask Number Question	Number of questions used requiring a single number as a response
49	ASK RNG	Ask Range Question	Number of questions used requiring the possible range on a number as a response
50	FEEDBACK	Feedback Command	Number of times Feedback command is used.
51	ERASE	Erase Activity Command	Number of times Erase Command is used
52	PRV.RVD.	Private Message Received	Number of private messages received
53	TOT.MSG.	Total Messages	The sum of public and private messages sent
54	TOT.WDS.	Total Words	Total number of words used in all messages
55	SESSDUR.	Session Duration	Number of hours of PLANET or FORUM use
56	TYP.TIME	Typing Time	The number of hours spent typing.
57	YEAR	Year	The calendar year
58	MONTH	Month	The month of the year
59	DATE	Date	The day of the year

Variable Code	Abbr.	Full Name	Description
60	LOC.DATE	Local date	The day of the year in local time
61	TOT.EDT.	Total Editing Characters	Number of all editing characters used (includes totals for individual editing characters)
62	TOT.CMD.	Total Commands	Number of all commands used (includes totals for individual commands)
63	SYN.ORD	Synchronous Order	The maximum number of persons who were present in an activity session at any time during the session
64	SYN.TIME	Synchronous Time	The total number of hours spent on activities when two or more participants are present at the same time in the activity
65	COST	Cost	Number of U.S. dollars spent on PLANET or FORUM use
66	PAC.TIME	Pacific Time	The day and hour according to Pacific time
67	LOC.TIME	Local Time	The day and hour according to local time
68	DISK	Disk Accesses	Number of computer disk accesses
69	NEW OLD	New/Old Participants	New Participants: The number of participants using PLANET or FORUM in the indicated month who had not used it in one or more of the previous months Old Participants: The number of participants using PLANET or FORUM in the indicated month who had used it in one or more of the previous months
70	INTRARRV	Inter-Arrival Time	The average time between sessions for a participant (requires data to be sorted by date)
71	DISK/HR.	Disk Accesses per Hour	Average computer disk accesses per Hour
72	COST/MSG.	Cost per Message	The average cost for a message expressed in U.S. dollars
73	COST/20W	Cost per 20 Words	Average cost for a 20 word message expressed in dollars
74	AVR.SESS	Average Session Length	Average session length in minutes
75	PART MAP	Participation Map	A table showing public messages, public verbosity, private messages, and private verbosity

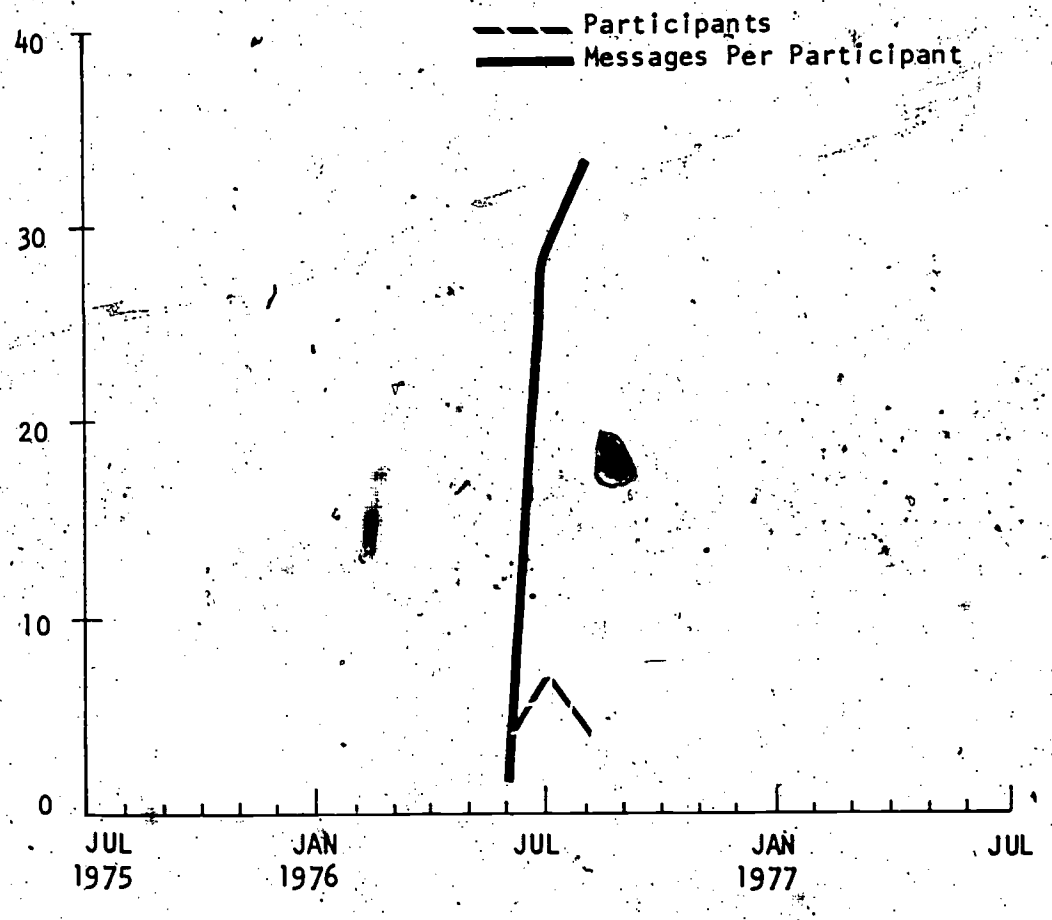
Variable Code	Abbr.	Full Name	Description
76	USGE/TIM	Usage by Time	A set of tables indicating the average number of lines in use at any given time of day (requires data to be sorted by date)
77	PRV.S&R	Private Messages Sent and Received	Total number of private messages sent and received
78	ORG.TIME	Organizer Time	Number of hours of PLANET or FORUM use spent as organizer of an activity
79	TIME OUTS	Time outside office Hours	Number of hours of PLANET or FORUM use spent outside of the hours 8-12 am and 1-5 pm local time
80	%OUT OFFC	Percent of Time Outside Office Hours	The ratio of time outside office to total usage time expressed as a percentage
81	WEEKBGIN	Week	The week beginning on the indicated date (Monday)
82	MSG.DLAY	Message Delay Time	The average number of hours between the time public messages were sent in activity and the time a participant received them.

APPENDIX E

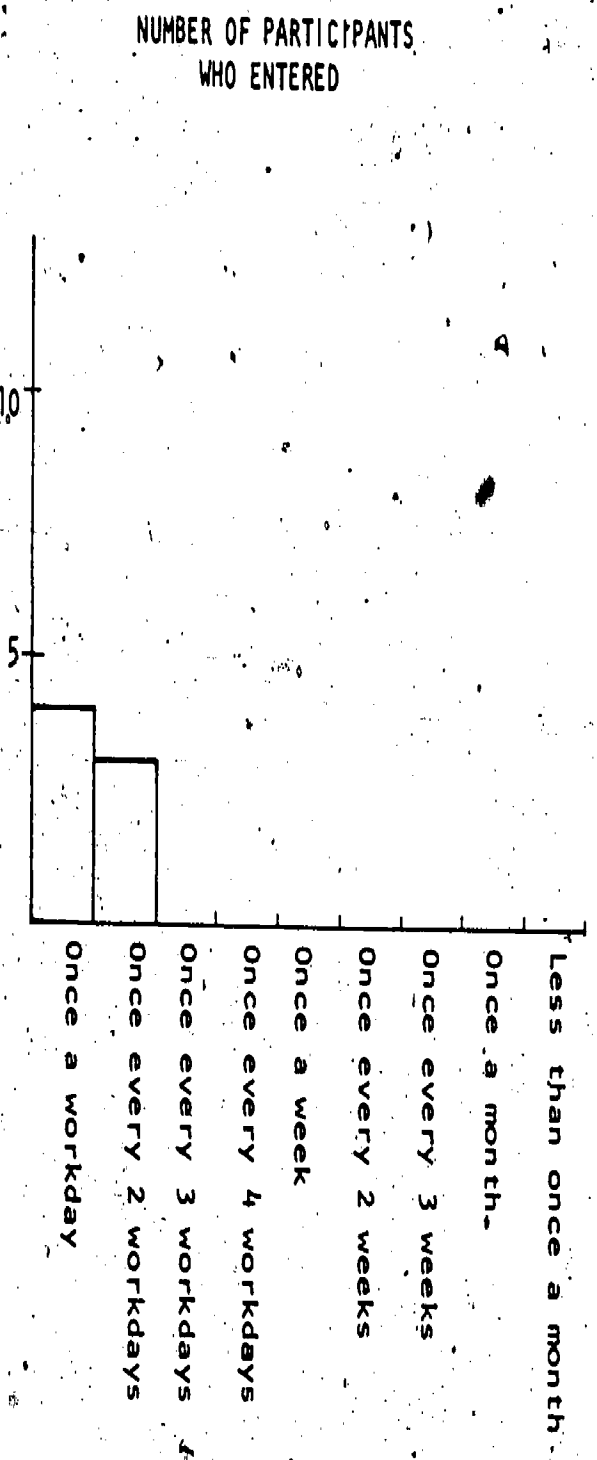
SELECTED USAGE STATISTICS DISPLAYED IN CHART FORM*

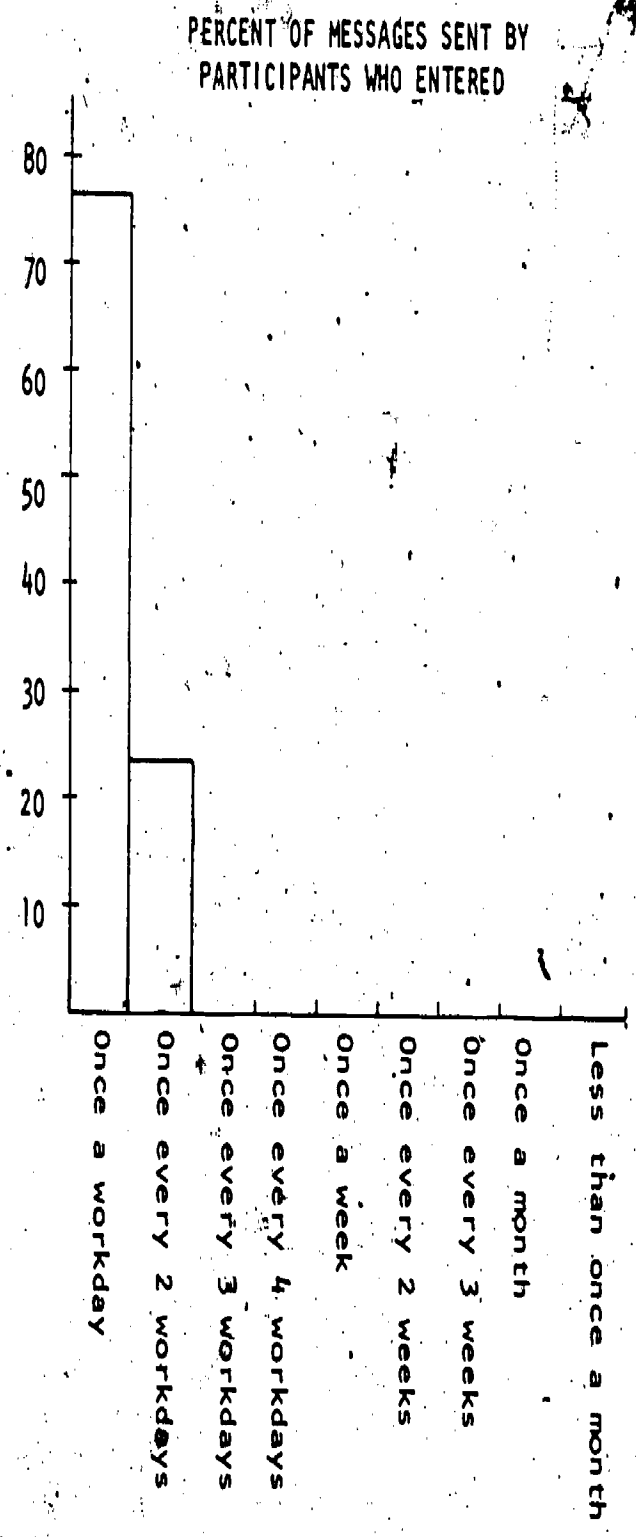
*In the order the groups appear in Chapter II, Table 3.

KETTERING: CPRP

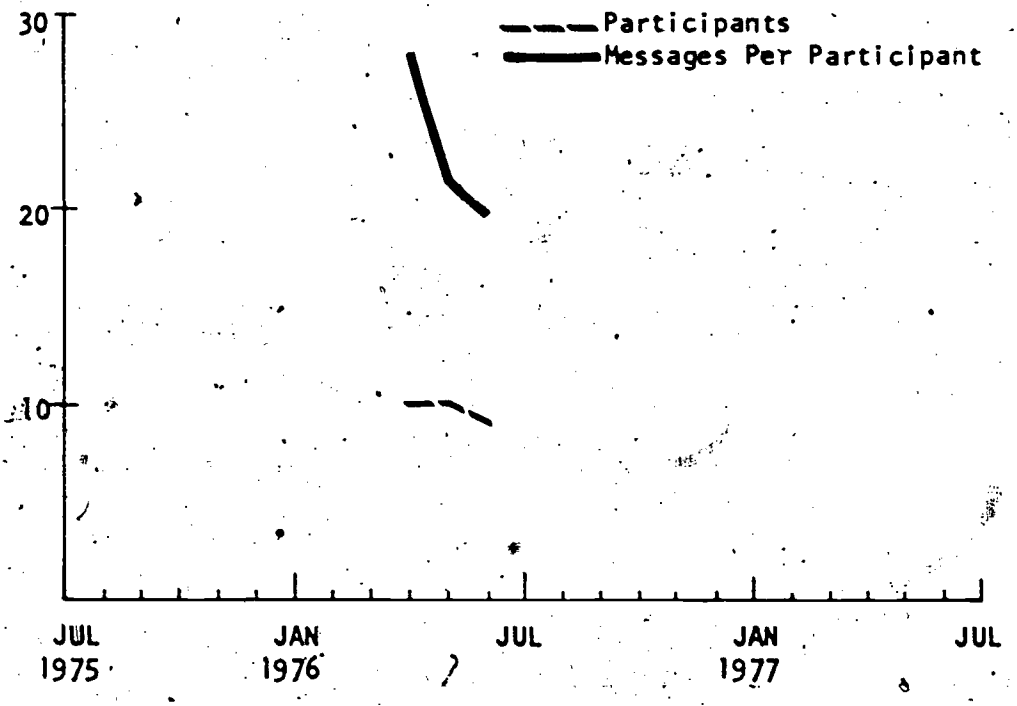


KETTERING: CPRP



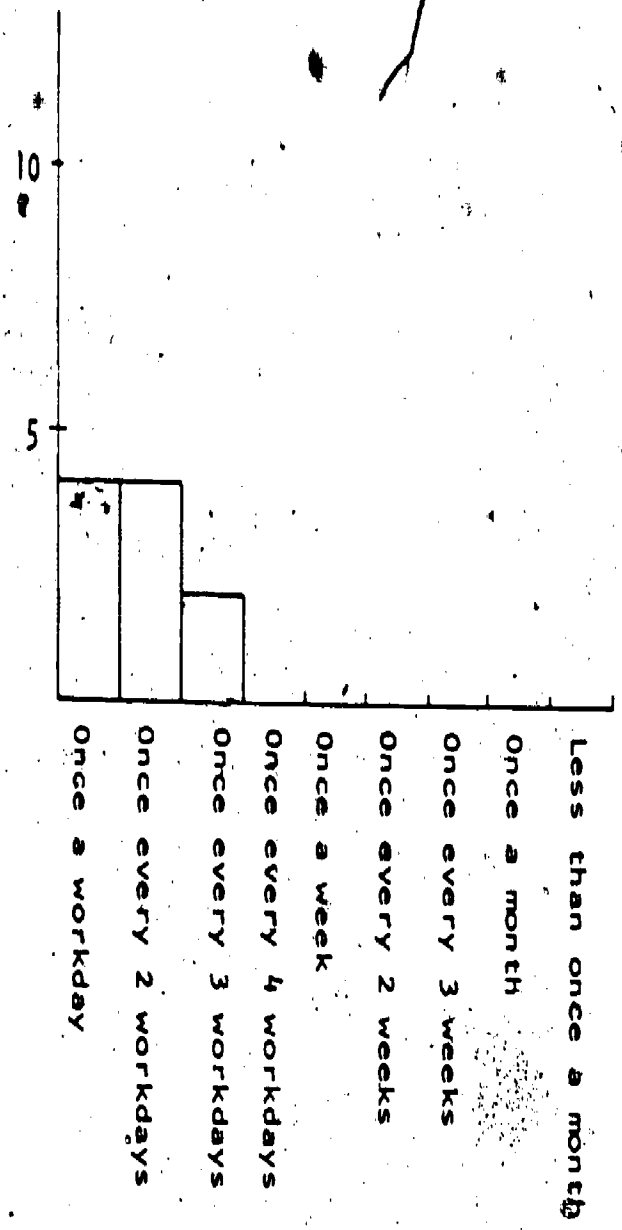


KETTERING: FOOD/CLIMATE

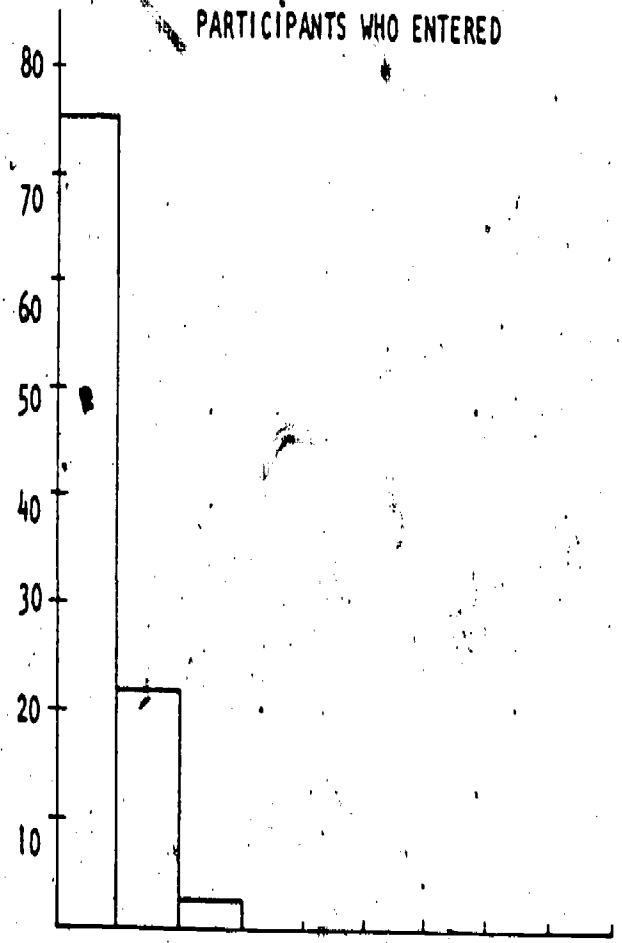


KETTERING: FOOD/CLIMATE

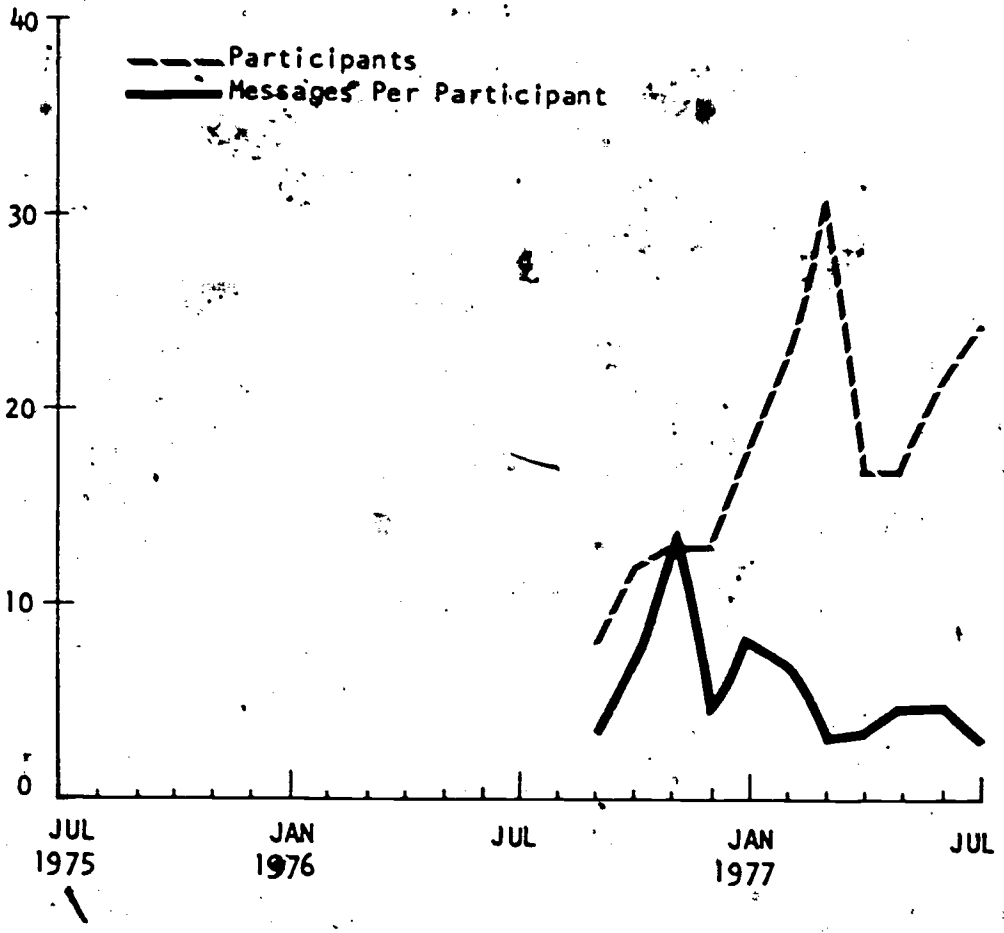
NUMBER OF PARTICIPANTS WHO ENTERED



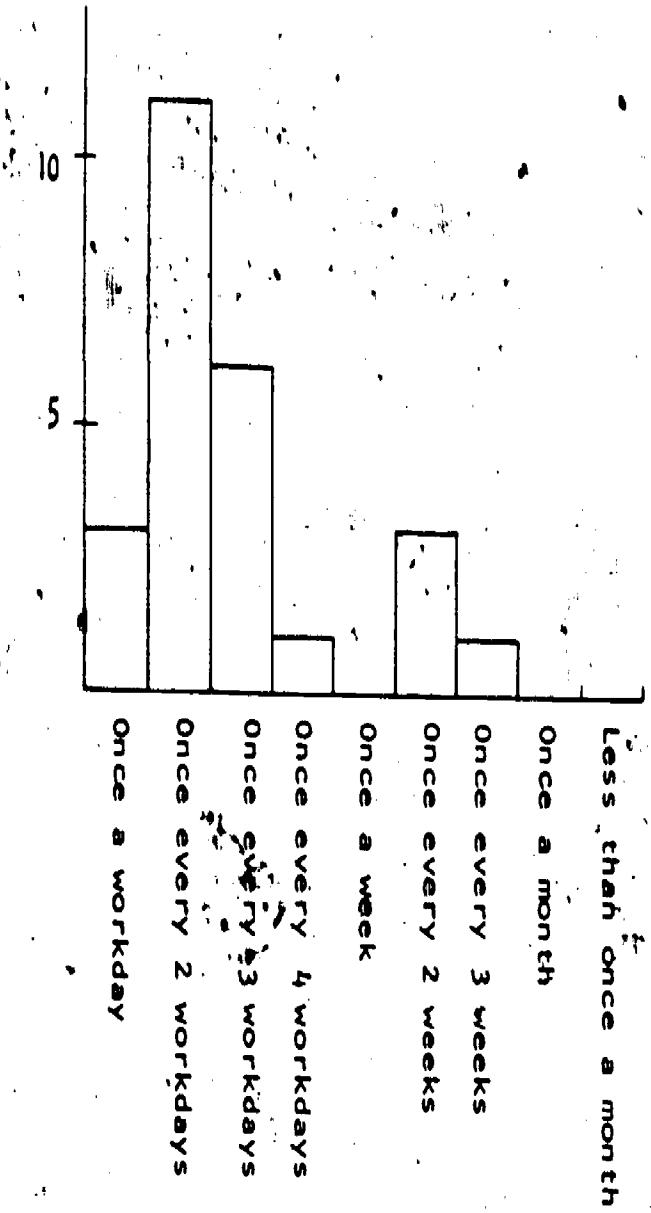
PERCENT OF MESSAGES SENT BY PARTICIPANTS WHO ENTERED



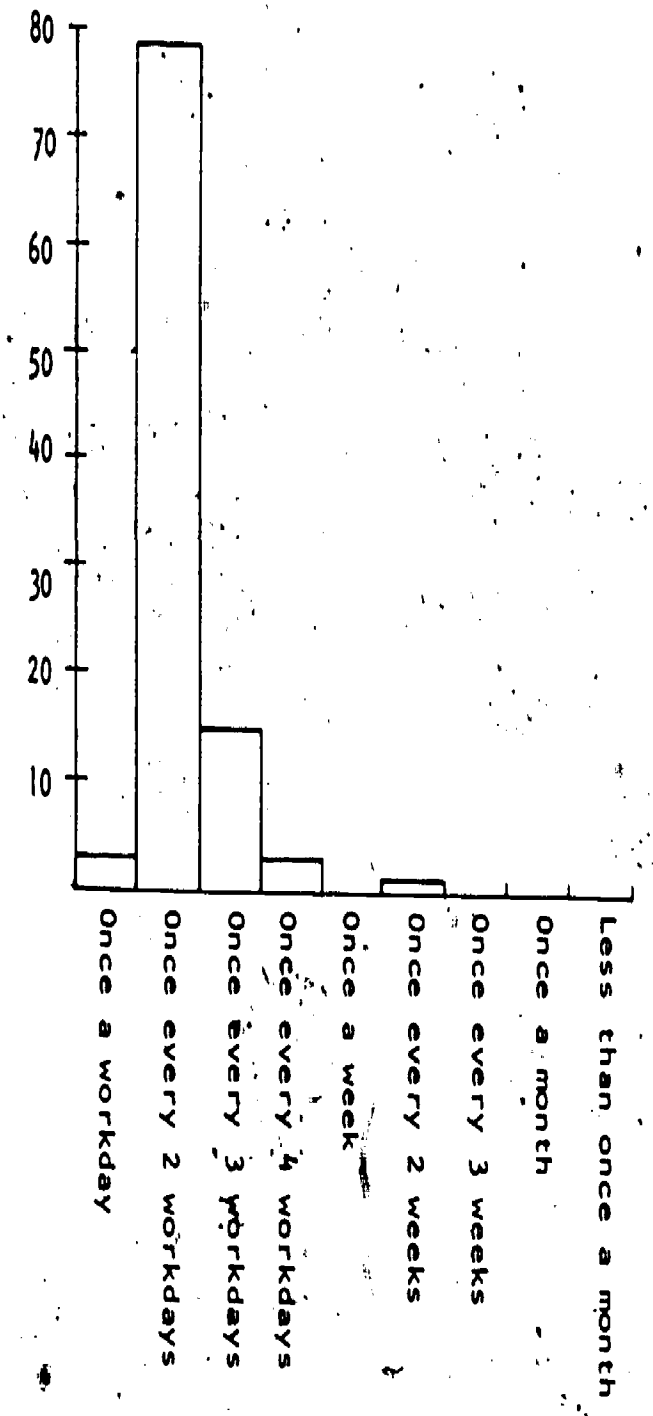
ERDA: IWGDE


40
30
20
10
0
Participants
Messages Per Participant
JUL 1975
JAN 1976
JUL
JAN 1977
JUL

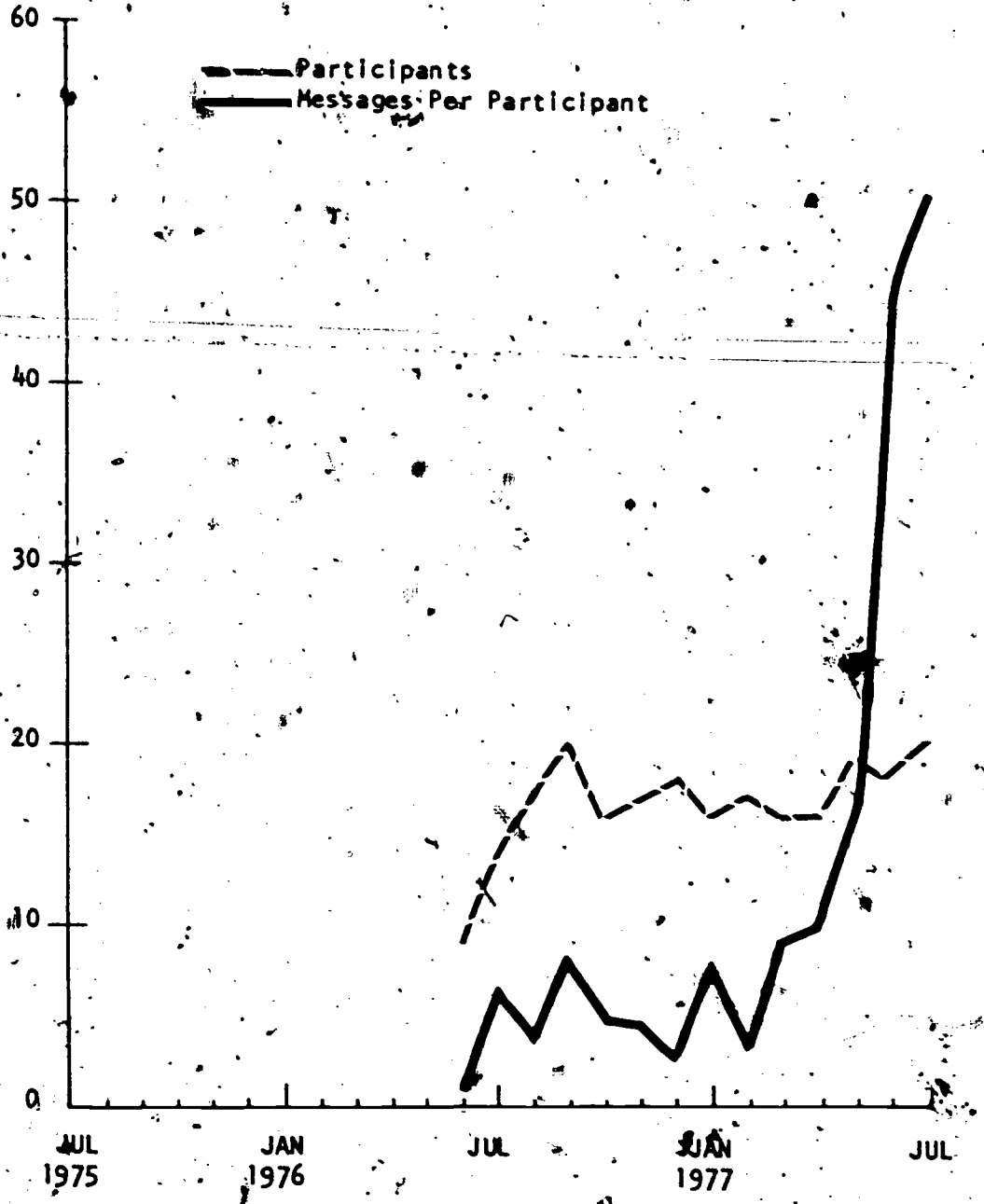
NUMBER OF PARTICIPANTS WHO ENTERED



PERCENT OF MESSAGES SENT BY PARTICIPANTS WHO ENTERED

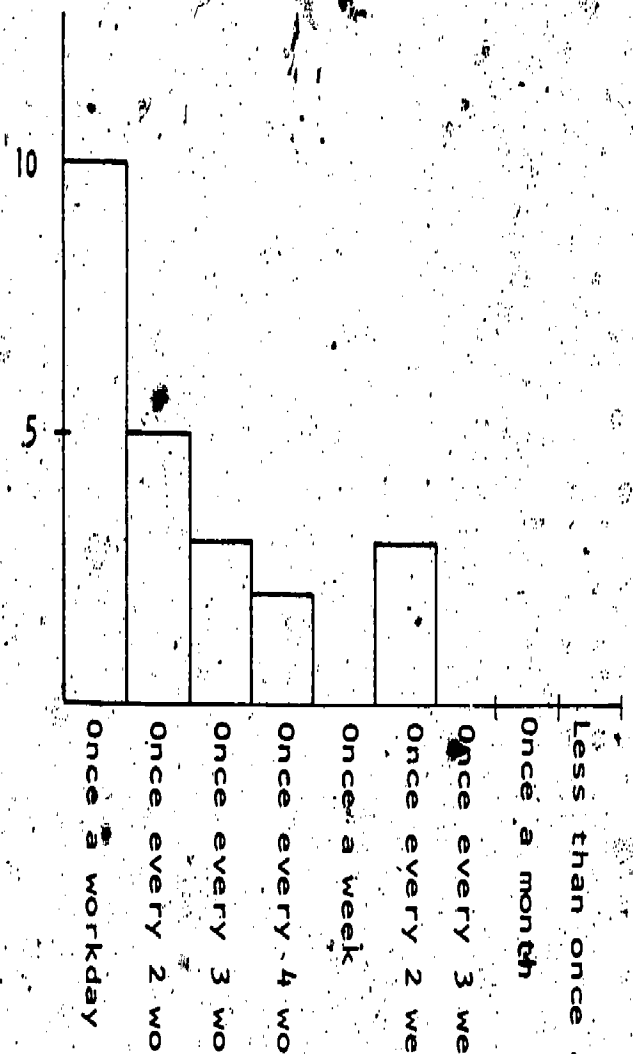


ERDA: NETWORK INVESTIGATORS

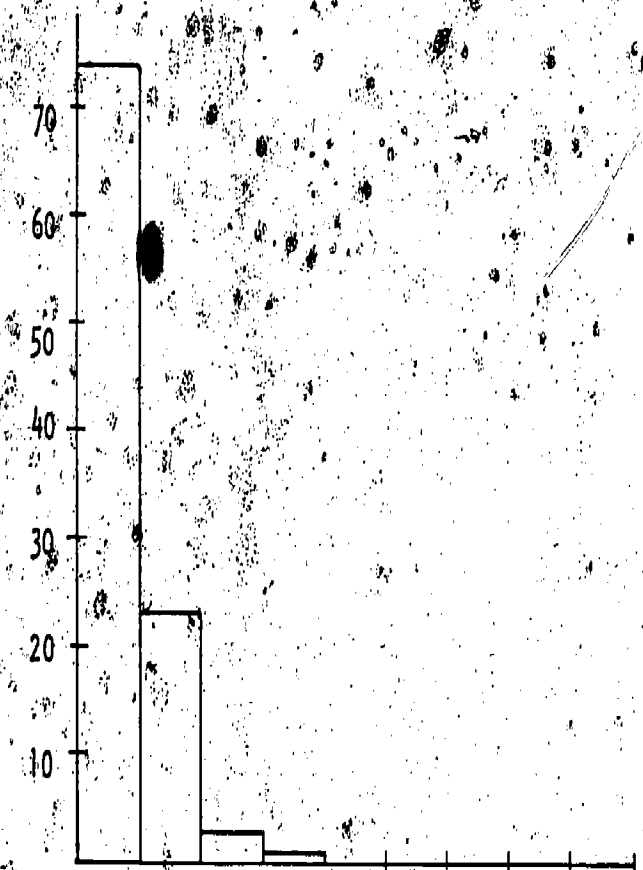


ERDA: NETWORK INVESTIGATORS

NUMBER OF PARTICIPANTS WHO ENTERED

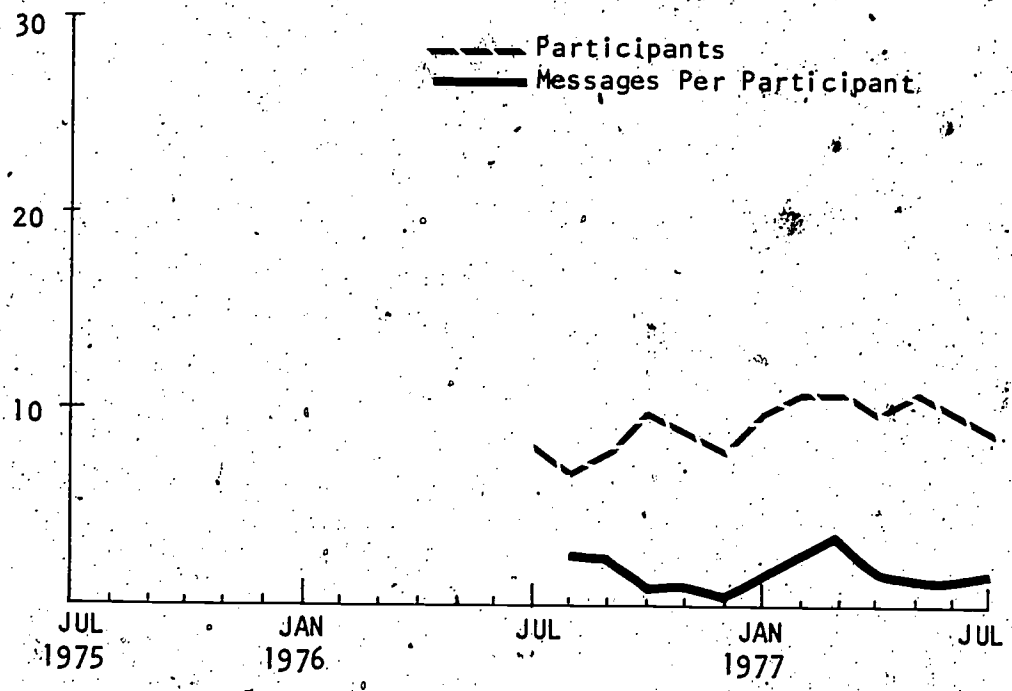


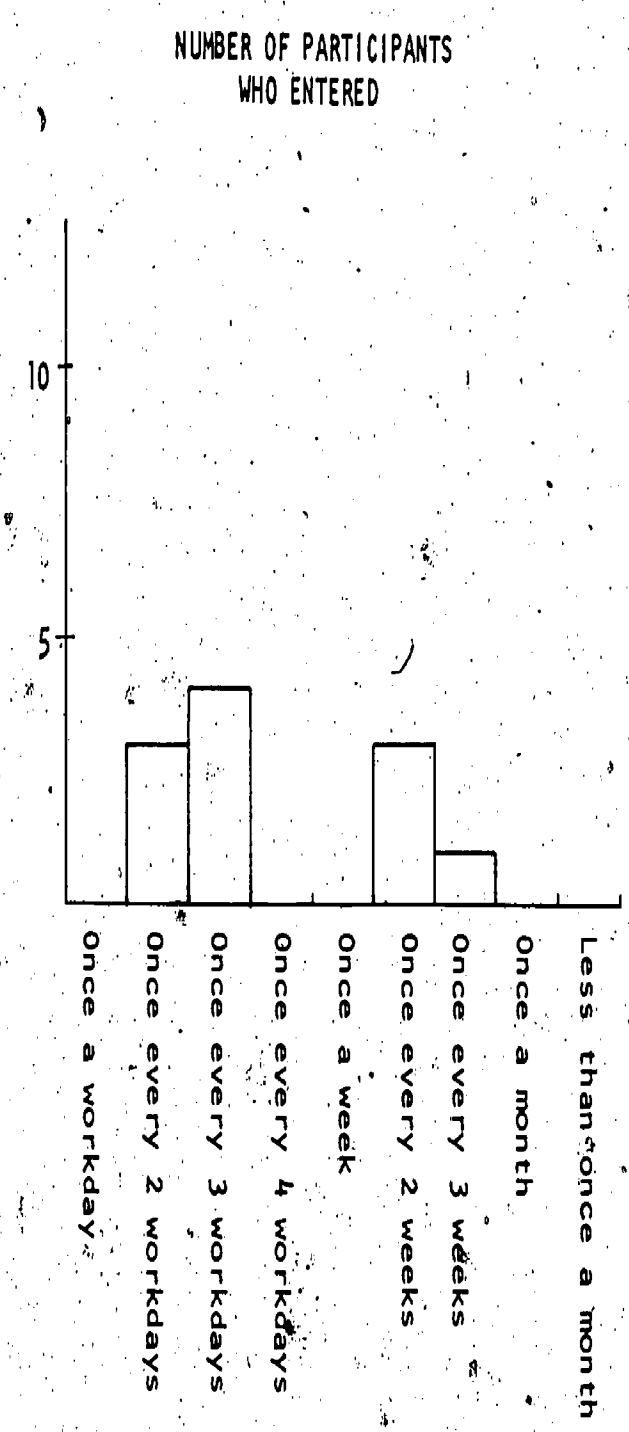
PERCENT OF MESSAGES SENT BY PARTICIPANTS WHO ENTERED

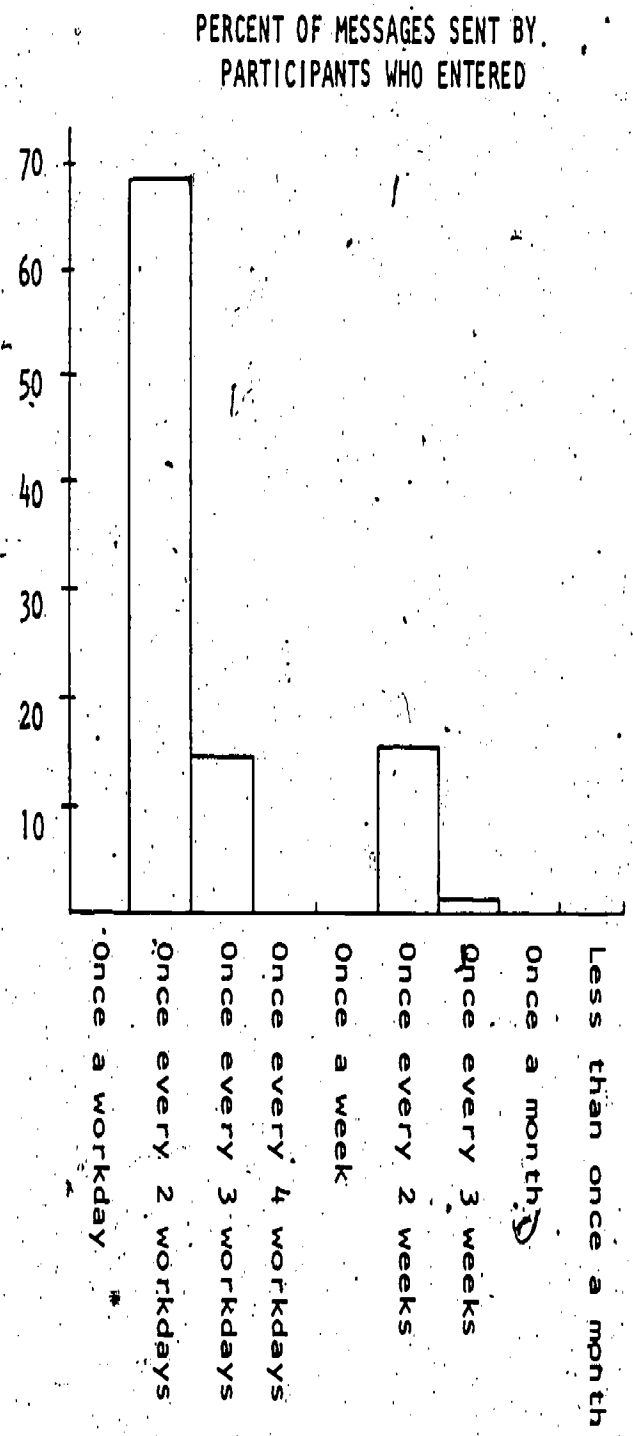


-145-

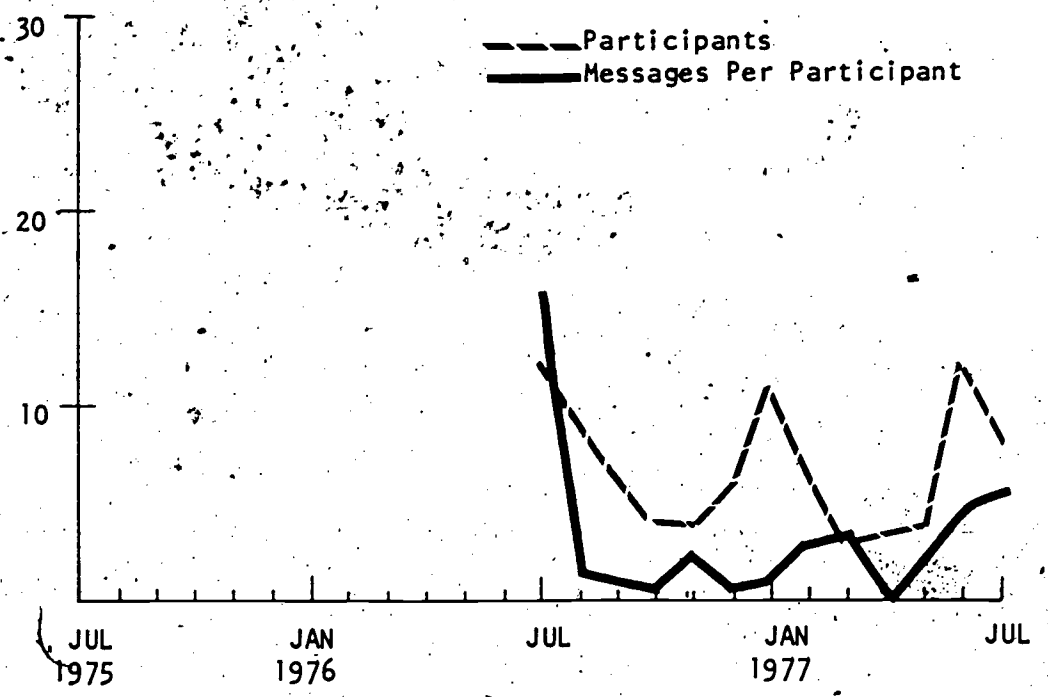
ERDA: NETWORK OBJECTIVES



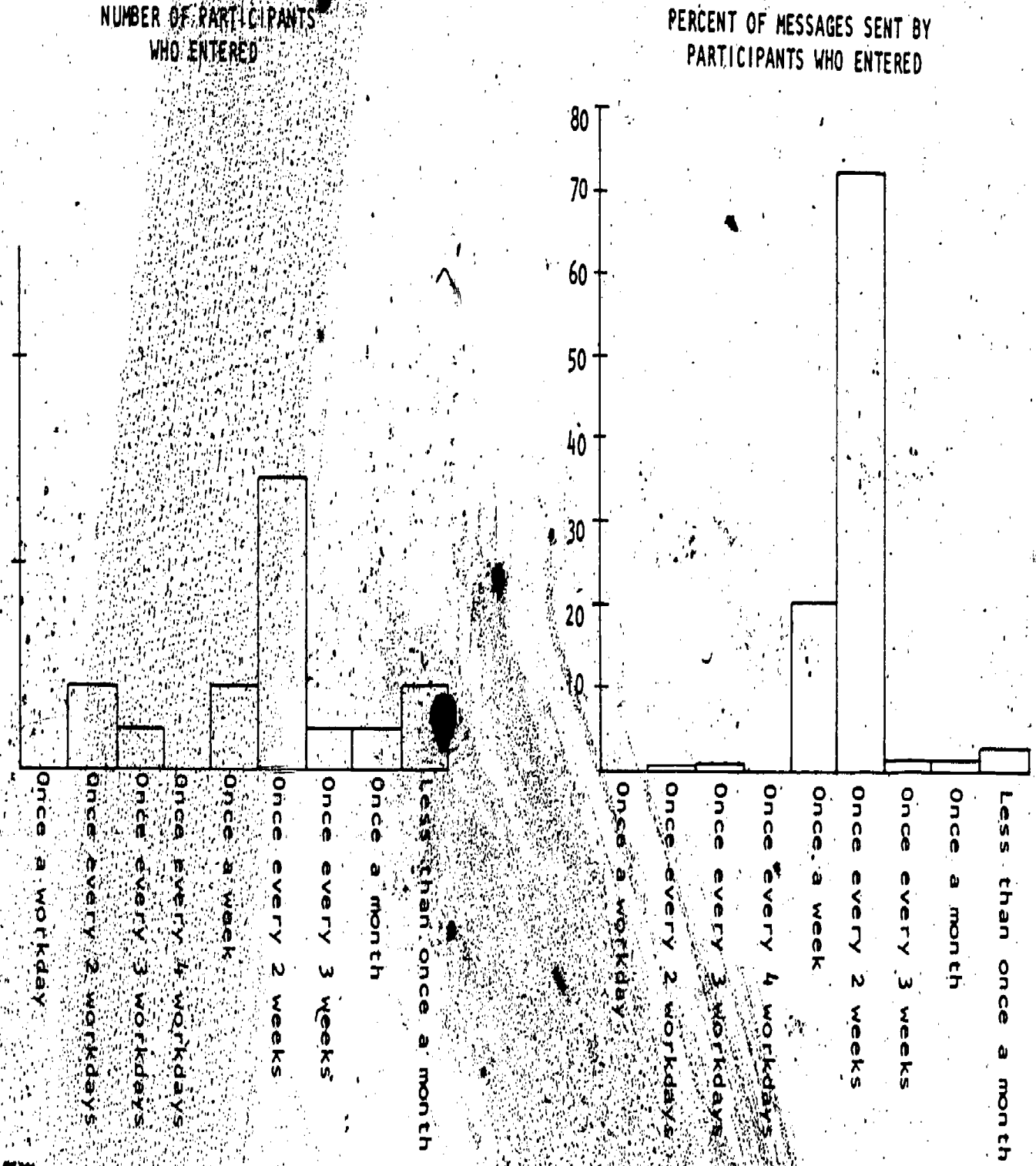

NUMBER OF PARTICIPANTS
WHO ENTERED
10
5
Once a workday
Once every 2 workdays
Once every 3 workdays
Once every 4 workdays
Once a week
Once every 2 weeks
Once every 3 weeks
Once a month
Less than once a month


PERCENT OF MESSAGES SENT BY
PARTICIPANTS WHO ENTERED
70
60
50
40
30
20
10
Once a workday
Once every 2 workdays
Once every 3 workdays
Once every 4 workdays
Once a week
Once every 2 weeks
Once every 3 weeks
Once a month
Less than once a month

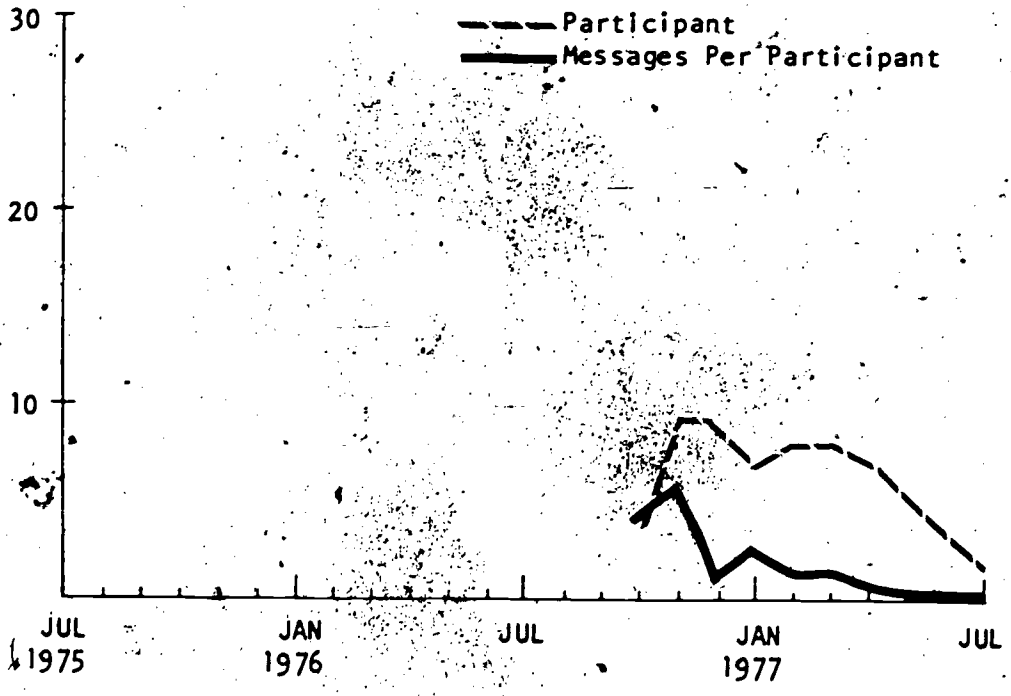
ERDA: BERKELEY DATA MANAGEMENT



ERDA: BERKELEY DATA MANAGEMENT

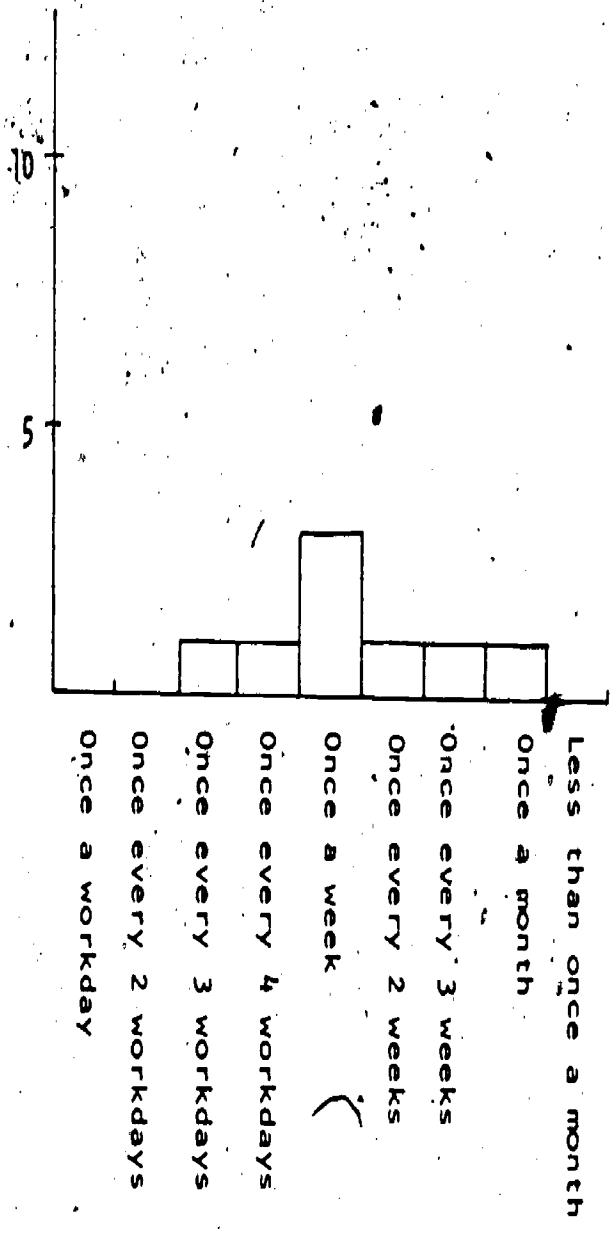


ERDA: NATIONAL COAL ASSESSMENT:
HEALTH EFFECTS

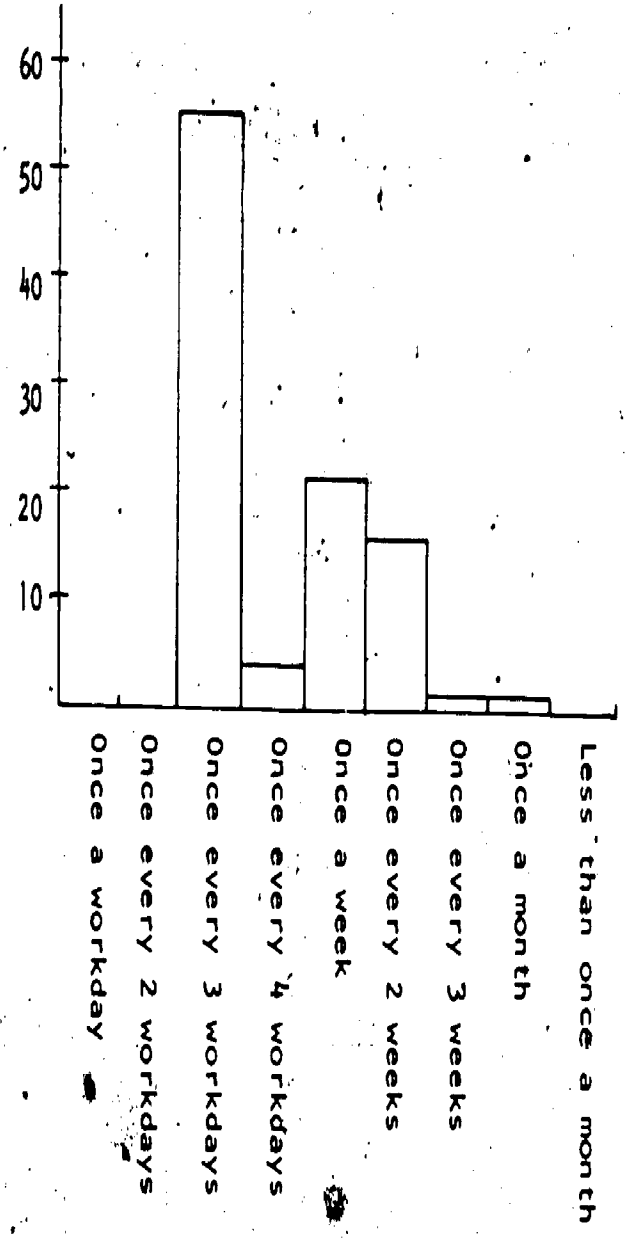


ERDA: NATIONAL COAL ASSESSMENT:
HEALTH EFFECTS

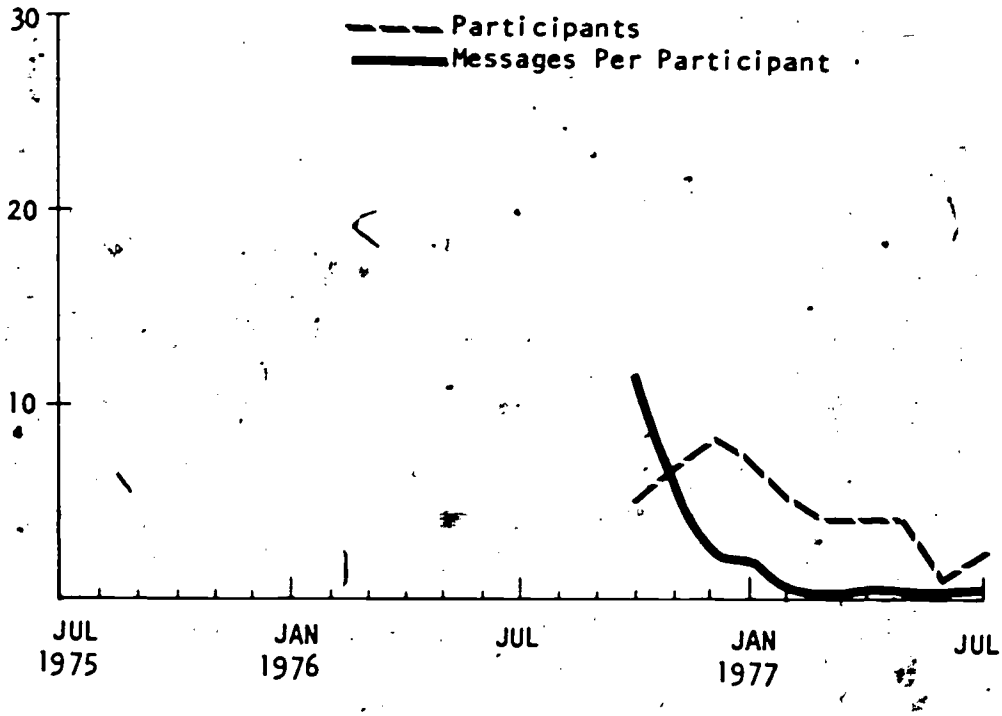
NUMBER OF PARTICIPANTS
WHO ENTERED



PERCENT OF MESSAGES SENT BY
PARTICIPANTS WHO ENTERED

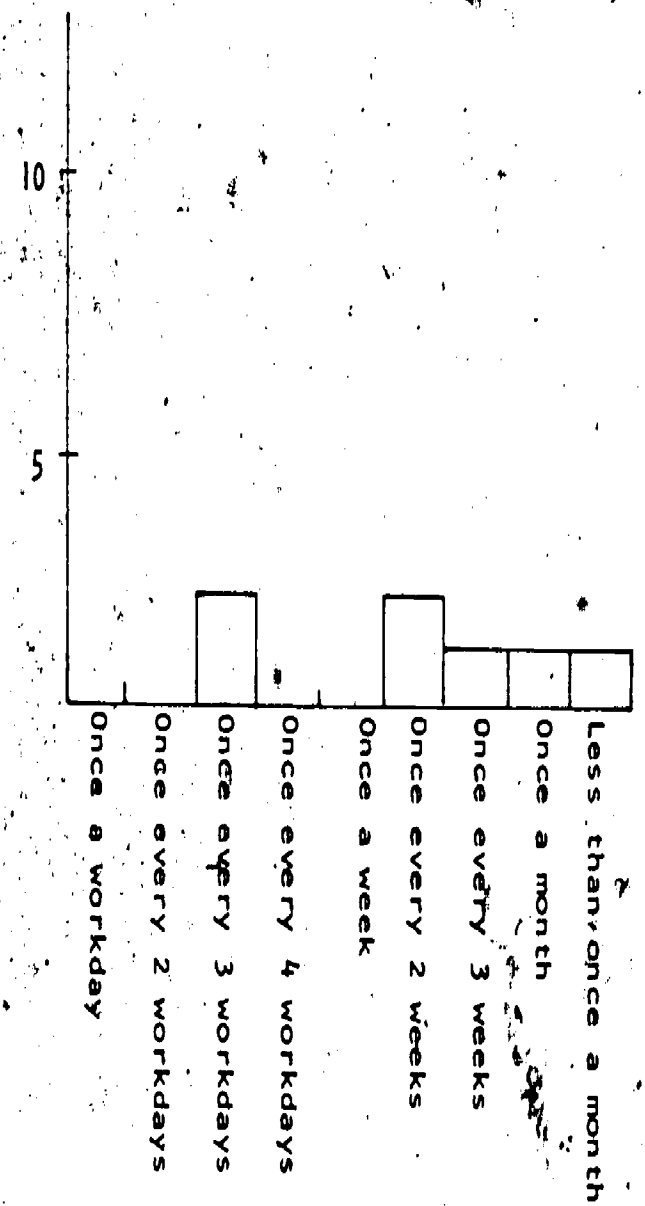


ERDA: NATIONAL COAL ASSESSMENT
WATER EFFECTS

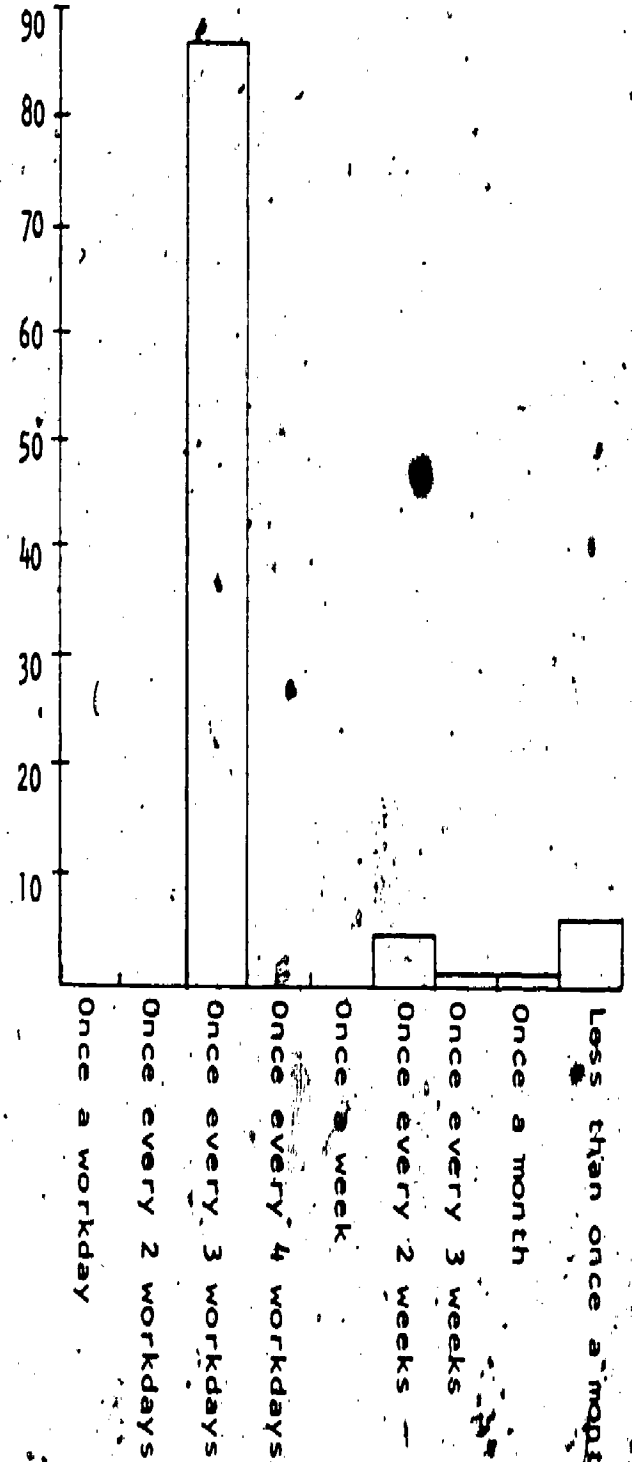


ERDA: NATIONAL COAL ASSESSMENT:
WATER EFFECTS

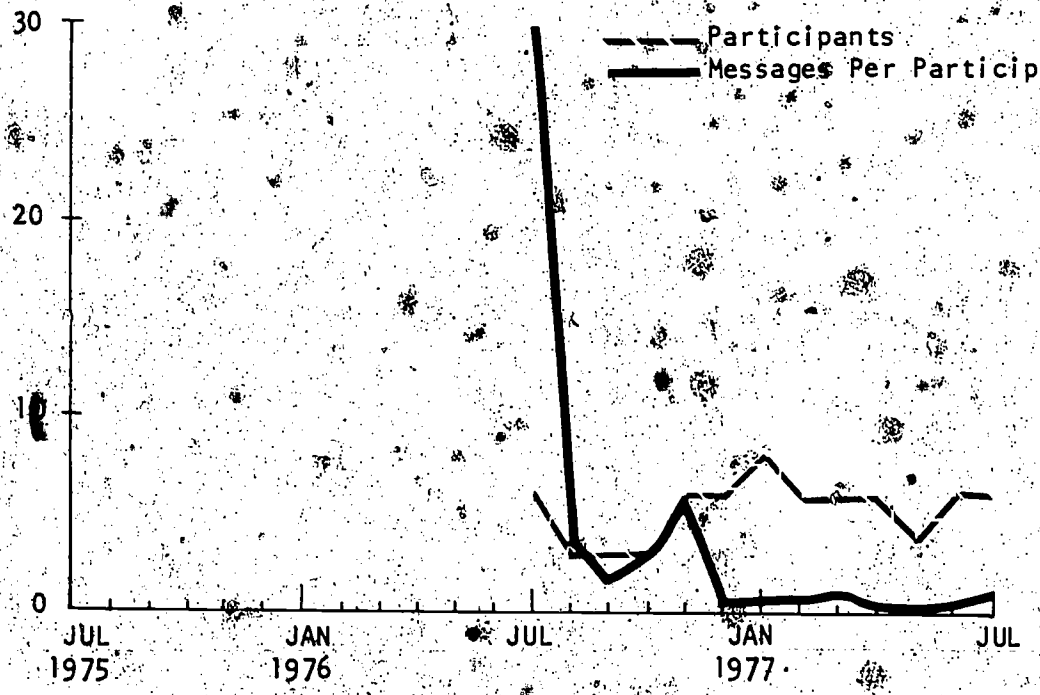
NUMBER OF PARTICIPANTS
WHO ENTERED



PERCENT OF MESSAGES SENT BY
PARTICIPANTS WHO ENTERED

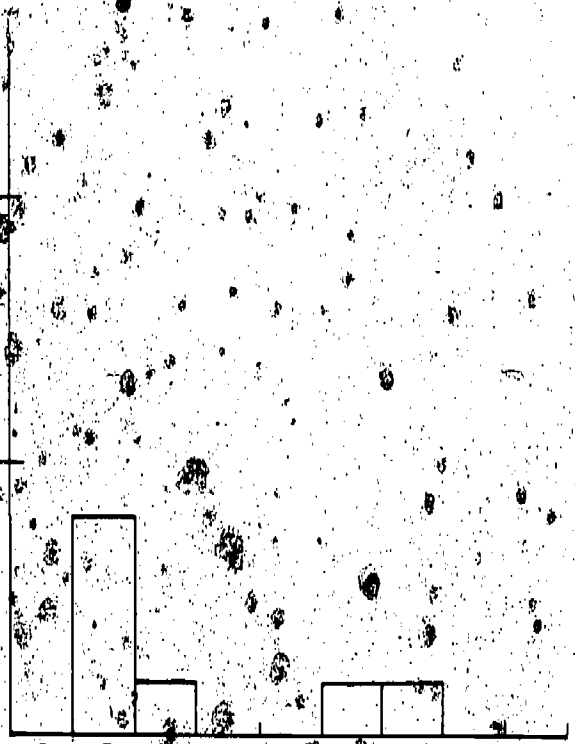


USGS: EARTHQUAKE PREDICTION

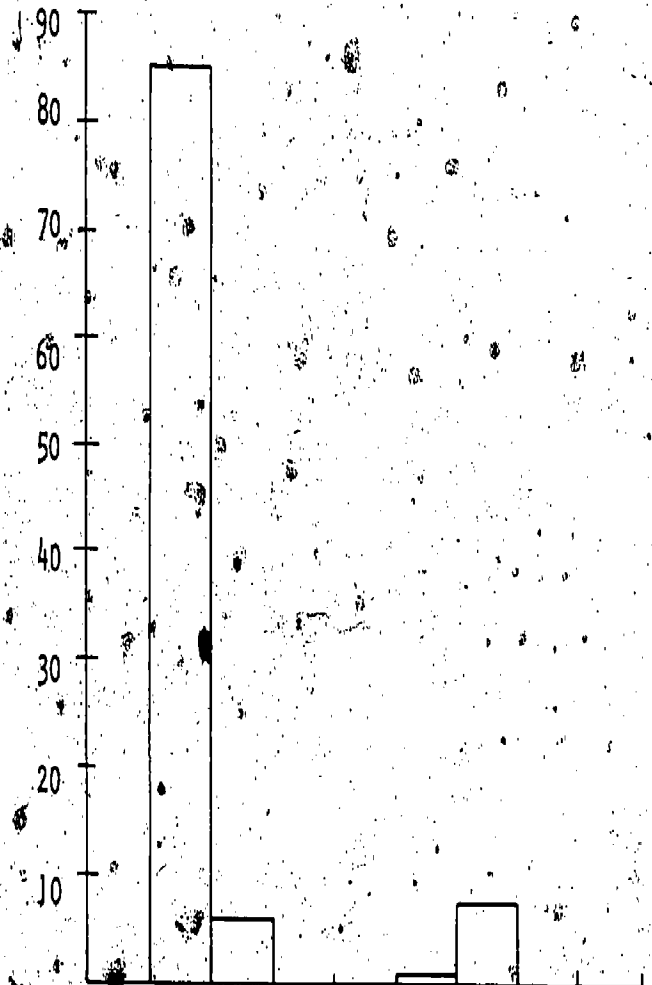


USGS: EARTHQUAKE PREDICTION

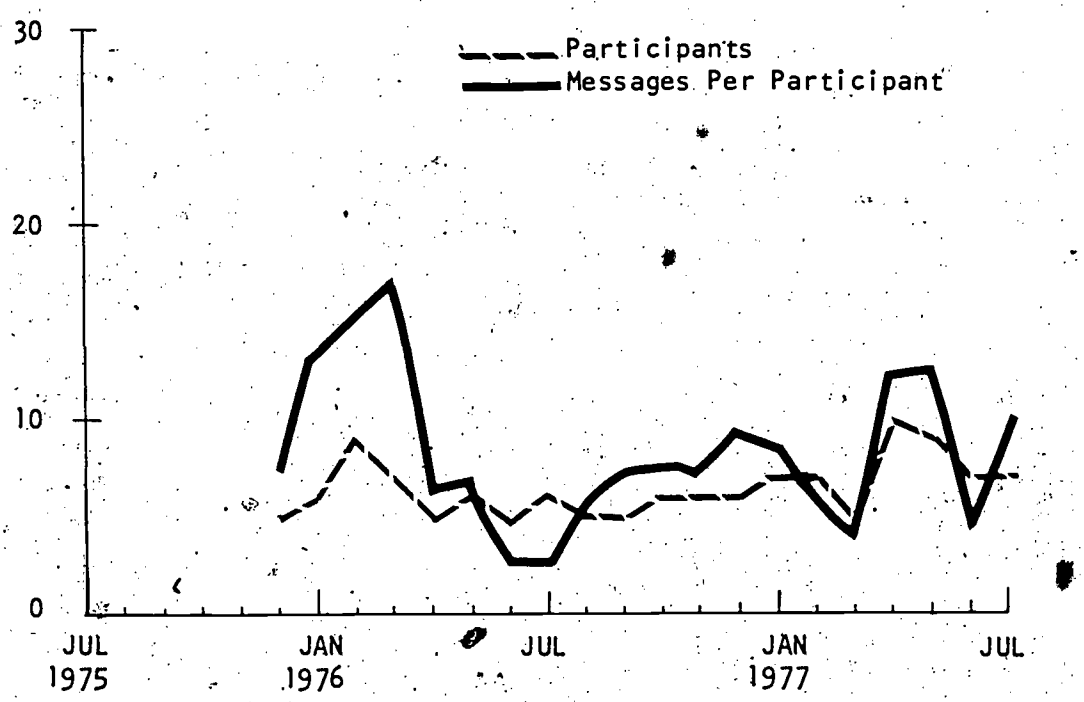
NUMBER OF PARTICIPANTS WHO ENTERED



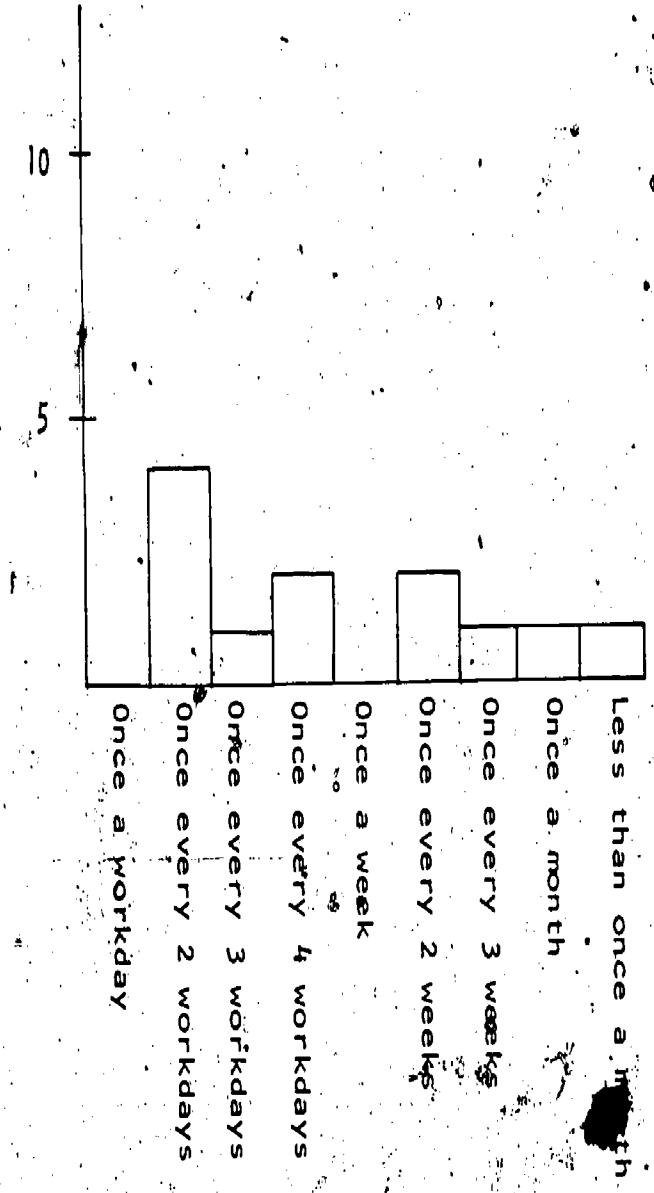
PERCENT OF MESSAGES SENT BY PARTICIPANTS WHO ENTERED



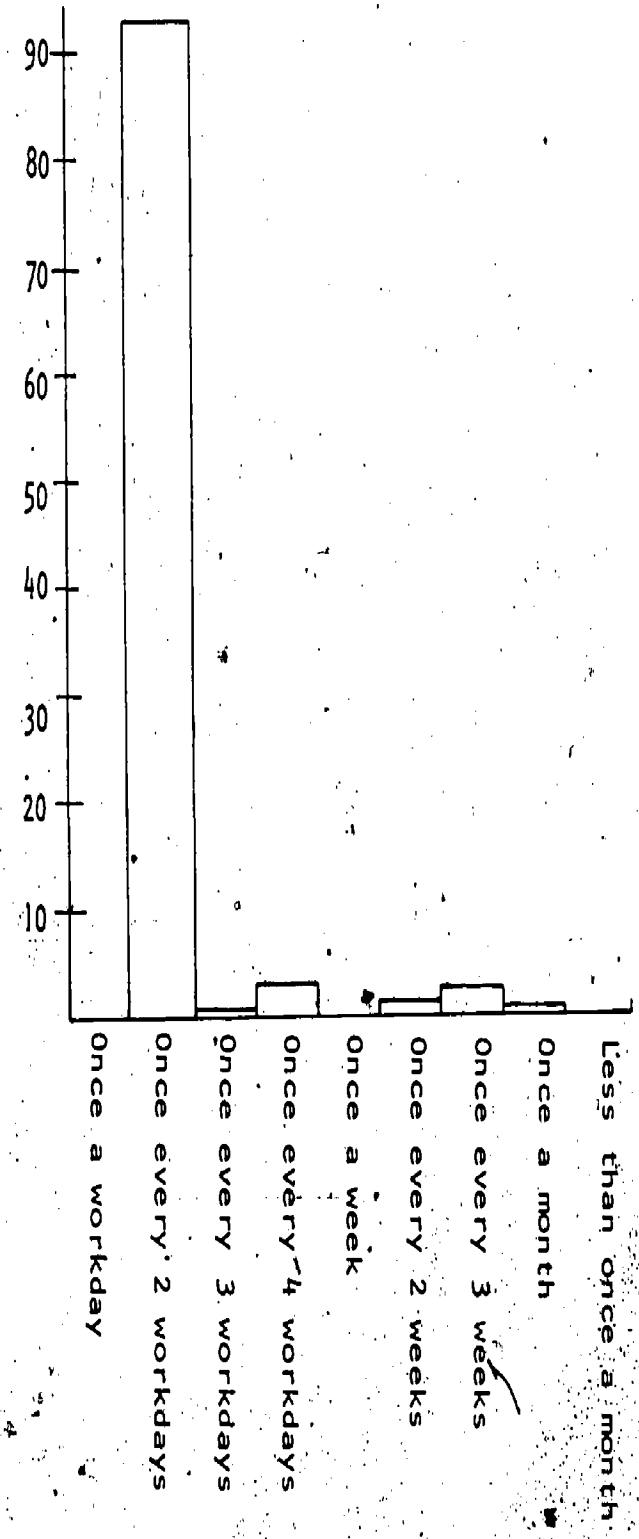
USGS: GRASP


30
20
10
0
Participants
Messages Per Participant
JUL
1975
JAN
1976
JUL
JAN
1977
JUL

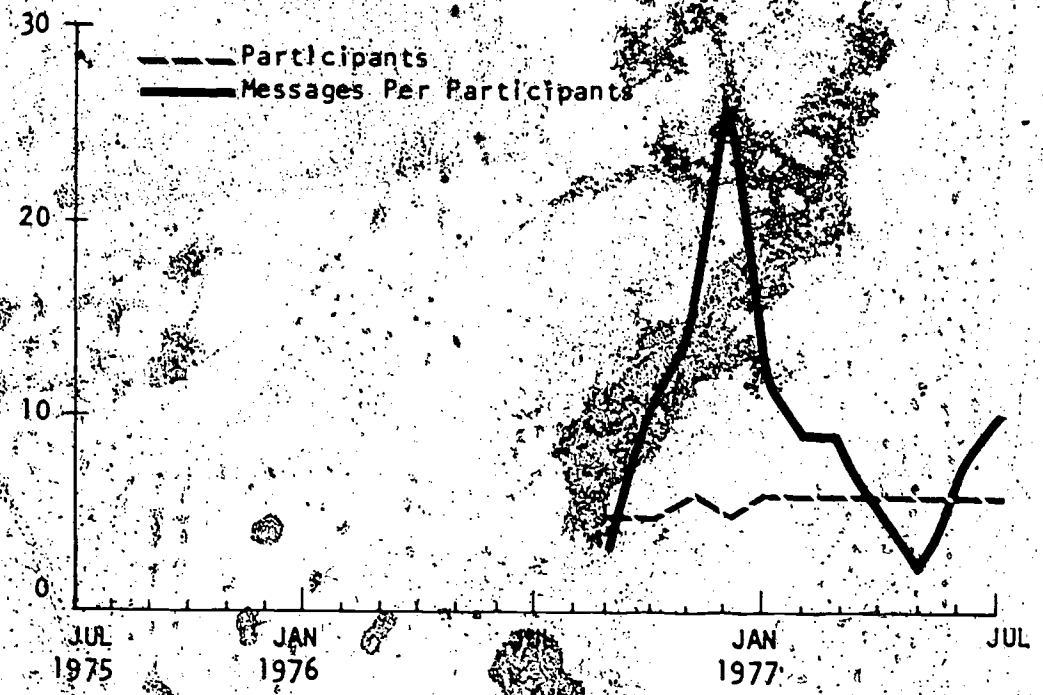
NUMBER OF PARTICIPANTS WHO ENTERED



PERCENT OF MESSAGES SENT BY PARTICIPANTS WHO ENTERED

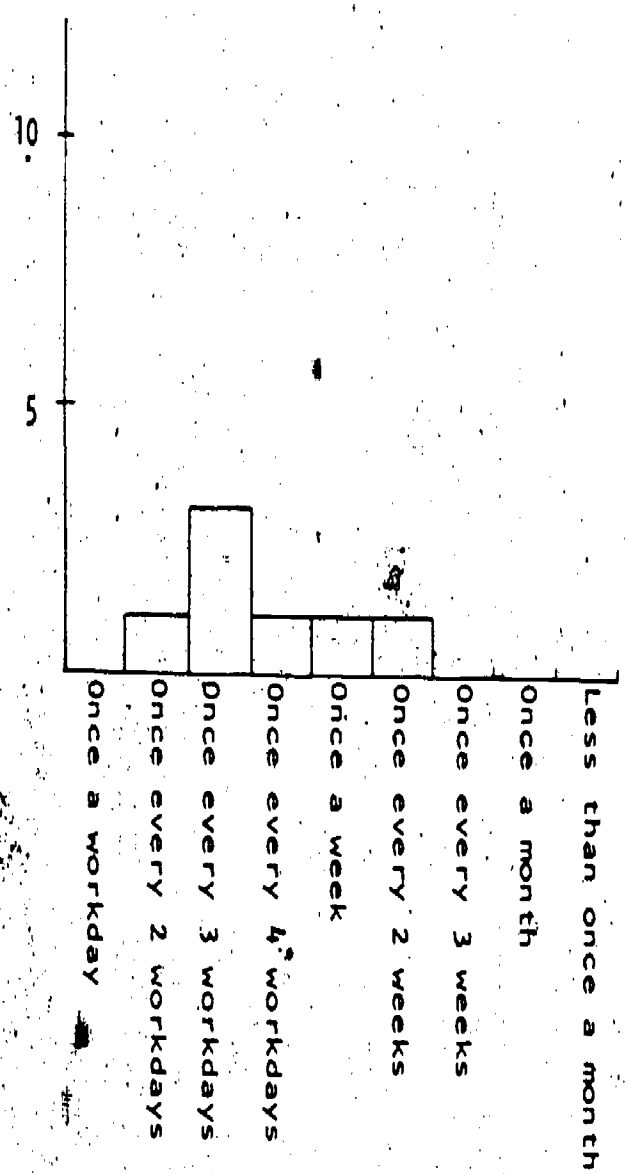


USGS: REMOTE OFFICE

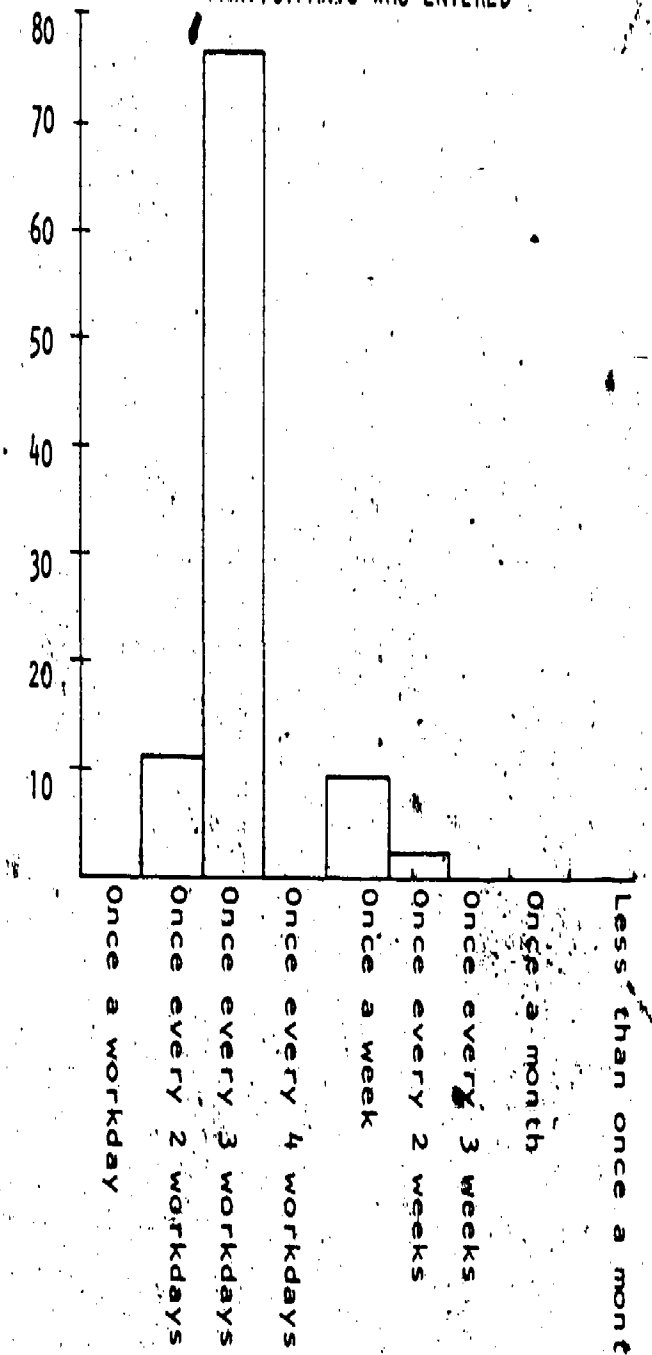


USGS: REMOTE OFFICE

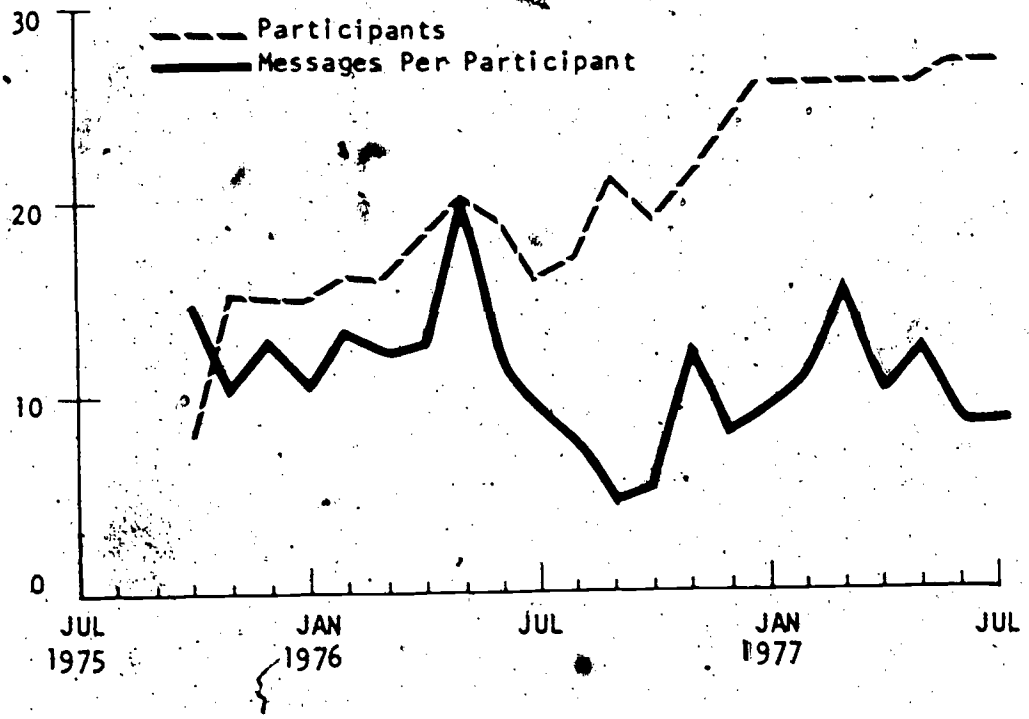
NUMBER OF PARTICIPANTS WHO ENTERED



PERCENT OF MESSAGES SENT BY PARTICIPANTS WHO ENTERED

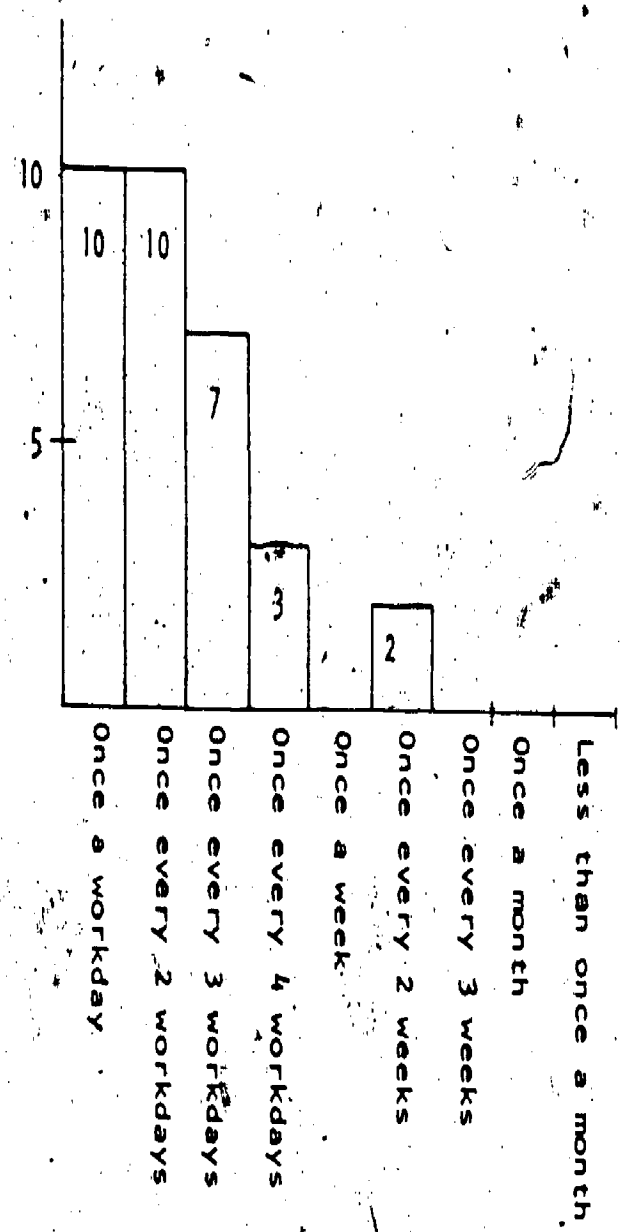


NASA: CTS

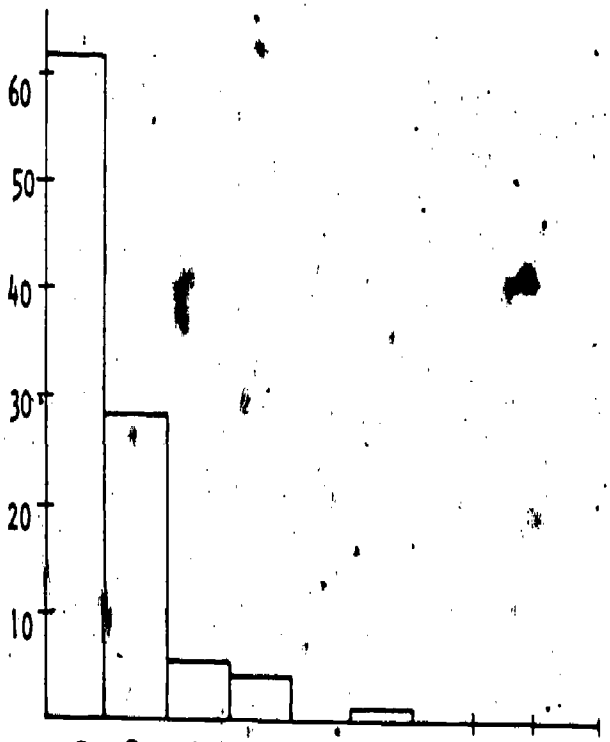

30
20
10
0
Participants
Messages Per Participant
JUL
1975
JAN
1976
JUL
JAN
1977
JUL

NASA: CTS

NUMBER OF PARTICIPANTS WHO ENTERED



PERCENT OF MESSAGES SENT BY PARTICIPANTS WHO ENTERED



APPENDIX F

DOCUMENTATION OF QUESTIONNAIRE ANALYSIS

QUESTIONNAIRE ANALYSIS

Aware of the inherent limits of our field test data, we kept our statistical analysis of questionnaire responses simple. We coded the questionnaire ordinally from 7 (for "daily") to 1 (for "less than once every three months").* Our basic statistic was each individual's change in questionnaire response over time. Then we examined the group average of individual changes to determine if they were statistically significant using a student's t distribution.

For example, if a participant responded that he or she communicated with researchers in other disciplines "about once a week" (5 on the ordinal scale) on the first questionnaire and "daily" (7) on the second, his or her actual change between the 1st and 2nd questionnaire would be 2 (7 minus 5). We followed the same procedure for the change between the 2nd and 3rd questionnaires and the 1st and 3rd questionnaires. Then we calculated the average change for all the individuals within each group (NASA, ERDA, USGS, low-usage) for each questionnaire interval (1st and 2nd, 2nd and 3rd, 1st and 3rd).

INITIAL ATTEMPTS AT ANALYSIS

We first tried to analyze the questionnaire data by simply computing the group means for each questionnaire sample, without comparing individuals over time. As a result, we included individuals who had answered only one or two of the possible three questionnaires. This introduced a great deal of uncertainty due to the variance within each sample. We then tried different methods to limit this variance.

---

*See questionnaire, Appendix C.

First, we tried two *coding procedures:* ordinal (7-1) and interval (60, 36, 12, 6, 3, 2, 1). The interval scale was based on the intervals indicated on the questionnaire. However, after computing basic statistics for our sample, it was clear that the interval scale introduced even more variance into calculations. Although ordinal data does not reflect the proper magnitude of changes occurring, it does result in more accurate statistics. Secondly, we tested a number of *questionnaire category groupings* to collapse the number of choices and increase frequencies, in hopes of lowering variances. However, it became clear that almost every method of combining categories created problems. One system would reflect certain changes clearly and affect other trends.

Finding that we could not limit variance through either of these methods, we decided to base our analysis upon individual changes in questionnaire response. This dramatically decreased our variance because our sample populations included only those participants who actually answered both tests for any of the three questionnaire intervals (1st and 2nd, 2nd and 3rd, 1st and 3rd).

LIMITS ON STATISTICAL ANALYSIS

In analyzing the questionnaire data, we have kept in mind the limits of our time series design. Though our original intention was to gather five data points, the design was reevaluated after adverse reactions to the frequency of questionnaires and a drop in response rate. We also noticed that the scale of changes perceived at three-month intervals did not warrant such frequency. Thus, we decided to collect only three data points: an initial, a midpoint, and a final questionnaire. Unfortunately, the initial questionnaire could not always be administered before PLANET usage began.

Another limit on the validity of our analysis is the small size of our samples. Because computer conferences are small (5 to 25 people) and response rates for some groups were low, total sample sizes per questionnaire period were low, ranging from 2 to 20. Also, respondents did not consistently return questionnaires for each time period. Since our statistical analysis depends upon comparing differences in responses by individual, this inconsistency further limits sample sizes.

APPENDIX G

MEAN QUESTIONNAIRE RESPONSES AND ACTUAL CHANGES FOR COMBINED GROUPS*

*As designated in Chapter III and Appendix F. See Appendix C for actual questionnaire and coding scale for interpreting statistics.

MEAN QUESTIONNAIRE RESPONSES FOR NASA

How frequently do you do each of the following:	1st Sample Mean based upon comparison with: 2nd Sample	1st Sample Mean based upon comparison with: 3rd Sample	2nd Sample Mean based upon comparison with: 1st Sample	2nd Sample Mean based upon comparison with: 3rd Sample	3rd Sample Mean based upon comparison with: 1st Sample	3rd Sample Mean based upon comparison with: 2nd Sample
Communicate with researchers in your own organization	6.9	7.0	6.9	7.0	7.0	6.9
Communicate with local researchers	6.2	6.8	6.1	4.7	5.8	4.8
Communicate with national researchers	6.091	6.167	5.4545	5.3	6.0	5.2
Communicate with international researchers	3.9	4.333	3.4	2.556	3.667	2.778
Communicate with researchers in other disciplines	4.5	5.167	4.9	4.111	5.333	4.556
Work at home	4.0	4.8333	4.1818	4.4	4.5	4.6
Work outside of normal office hours	5.4545	5.667	5.0	5.556	5.5	5.333
Read work-related literature	6.2	6.167	6.1	6.111	6.0	6.111
Exchange letters with other researchers	4.727	5.0	4.636	4.1	5.5	4.7
Use the telephone to communicate with other researchers	6.818	6.833	6.545	6.1	7.0	6.6
Travel for discussions with other researchers	3.273	3.667	3.0	2.6	2.5	2.8
Other communication	6.2	6.2	6.4	5.2	5.8	4.2
How satisfied are you with communication with distant researchers?	3.818	4.167	4.091	3.9	4.167	4.0

ACTUAL CHANGE IN QUESTIONNAIRE RESPONSES
(BY INDIVIDUALS) FOR NASA

How frequently do you do each of the following:	Change between 1st and 2nd questionnaire		Change between 2nd and 3rd questionnaire		Change between 1st and 3rd questionnaire	
	Average Change	Significance	Average Change	Significance	Average Change	Significance
Communicate with researchers in your own organization						
Communicate with local researchers					-1.0	99.9
Communicate with national researchers	-.6364	92.4				
Communicate with international researchers	-.50	82.8			-.6667	77.8
Communicate with researchers in other disciplines			.4444	91.5		
Work at home			.20	77.8		
Work outside of normal office hours	-.4545	87.9				
Read work-related literature						
Exchange letters with other researchers			.60	97.4	.50	79.2
Use the telephone to communicate with other researchers	-.2727	80.4	.50	95.2	-.1667	99.9
Travel for discussions with other researchers					-1.1667	92.2
Other communication			1.0	87.0		
How satisfied are you with communication with assistant researchers?	.2727	78.4				

MEAN QUESTIONNAIRE RESPONSES FOR ERDA

How frequently do you do each of the following:	1st Sample Mean based upon comparison with: 2nd Sample	1st Sample Mean based upon comparison with: 3rd Sample	2nd Sample Mean based upon comparison with: 1st Sample	2nd Sample Mean based upon comparison with: 3rd Sample	3rd Sample Mean based upon comparison with: 1st Sample	3rd Sample Mean based upon comparison with: 2nd Samp
Communicate with researchers in your own organization	6.846	6.846	6.385	6.526	7.0	6.895
Communicate with local researchers	4.077	4.461	3.846	3.947	5.0	4.842
Communicate with national researchers	3.846	4.154	4.846	4.714	5.462	5.143
Communicate with international researchers	1.308	1.539	1.077	1.368	1.692	1.526
Communicate with researchers in other disciplines	4.0	4.417	4.25	4.05	5.083	4.5
Work at home	5.154	5.539	4.769	4.947	5.539	5.474
Work outside of normal office hours	5.923	6.0	6.154	6.15	6.077	6.25
Read work-related literature	5.769	6.077	5.0	5.316	5.615	5.526
Exchange letters with other researchers	3.462	4.0	3.0	2.947	3.615	3.053
Use the telephone to communicate with other researchers	5.077	5.385	5.308	5.6	5.308	5.3
Travel for discussions with other researchers	2.0	2.154	1.923	2.0	2.923	2.45
Other communication	4.1	4.1	6.1	5.938	5.6	5.688
How satisfied are you with communication with distant researchers?	2.154	2.308	3.615	3.619	3.846	3.809

ACTUAL CHANGE IN QUESTIONNAIRE RESPONSES
(BY INDIVIDUALS) FOR ERDA

How frequently do you do each of the following:	Change between 1st and 2nd questionnaire		Change between 2nd and 3rd questionnaire		Change between 1st and 3rd questionnaire	
	Average Change	Significance	Average Change	Significance	Average Change	Significance
Communicate with researchers in your own organization	-.4615	84.6	.3684	[illegible]	.1538	[illegible]
Communicate with local researchers			.8947	97	.6154	87
Communicate with national researchers	1.0	98.9	.4286	91	1.3077	99.8
Communicate with international researchers	-.2308	80.6			.1538	78.2
Communicate with researchers in other disciplines	.25	75.4	.45	92.8	.6667	93.2
Work at home	-.3846	82.2	.5263	88.9		
Work outside of normal office hours						
Read work-related literature	-.7692	94.1			.4615	91.7
Exchange letters with other researchers	-.4615	91.7			-.3846	86.6
Use the telephone to communicate with other researchers	.2308	80.6	-.3	85.7		
Travel for discussions with other researchers			.45	91.7	.7692	96.7
Other communication	2.0	99.9			1.5	[illegible]
How satisfied are you with communication with assistant researchers?	1.4615	99.9	.1905	74.6	1.5385	99.9

MEAN QUESTIONNAIRE RESPONSES FOR USGS

How frequently do you do each of the following:	1st Sample Mean based upon comparison with: 2nd Sample	1st Sample Mean based upon comparison with: 3rd Sample	2nd Sample Mean based upon comparison with: 1st Sample	2nd Sample Mean based upon comparison with: 3rd Sample	3rd Sample Mean based upon comparison with: 1st Sample	3rd Sample Mean based upon comparison with: 2nd Samp
Communicate with researchers in your own organization	6.667	7.0	6.0	6.4	7.0	6.6
Communicate with local researchers	4.667	5.333	3.667	4.8	5.333	4.4
Communicate with national researchers	3.5	5.0	3.5	4.5	5.333	4.75
Communicate with international researchers	3.333	4.667	4.333	3.6	4.333	3.6
Communicate with researchers in other disciplines	3.333	4.667	4.0	4.8	6.0	4.0
Work at home	5.0	4.667	4.667	3	4.333	3.6
Work outside of normal office hours	5.667	5.667	5.0	5.0	3.667	4.2
Read work-related literature	5.667	6.0	5.333	5.4	4.333	5.0
Exchange letters with other researchers	4.0	5.333	4.0	4.8	5.0	3
Use the telephone to communicate with other researchers	5.0	6.3	4.333	6.4	6.3	5.6
Travel for discussions with other researchers	3.667	4.333	3.333	2.4	3.333	2.2
Other communication	6.0	6.0	6.0	5.0	6.5	4.75
How satisfied are you with communication with distant researchers?	4.333	4.667	4.0	3.8	4.333	4.0

ACTUAL CHANGE IN QUESTIONNAIRE RESPONSES
(BY INDIVIDUALS) FOR USGS

How frequently do you do each of the following:	Change between 1st and 2nd questionnaire		Change between 2nd and 3rd questionnaire		Change between 1st and 3rd questionnaire	
	Average Change	Significance	Average Change	Significance	Average Change	Significance
Communicate with researchers in your own organization	-.6667	78.8				
Communicate with local researchers	-1.0	78.8				
Communicate with national researchers						
Communicate with international researchers	1.0	88.7			1.3333	99.9
Communicate with researchers in other disciplines	.6667	78.8				
Work at home	-.3333	78.8				
Work outside of normal office hours	-.6667	78.8	-.8	99.2	-2.0	96.3
Read work-related literature	-.3333	78.8	-.4	91.1	-1.6667	99.9
Exchange letters with other researchers			-1.0	88.7		
Use the telephone to communicate with other researchers	-.6667	78.8				
Travel for discussions with other researchers	-.3333	78.8	-.2	81.3	-1.0	88.7
Other communication					.5	99.7
How satisfied are you with communication with [illegible]tant researchers?	-.3333	99.9	.2	78.8	-.3333	81.3

MEAN QUESTIONNAIRE RESPONSES
FOR LOW-USAGE GROUPS

How frequently do you do each of the following:	1st Sample Mean based upon comparison with:		2nd Sample Mean based upon comparison with:		3rd Sample Mean based upon comparison with:	
	2nd Sample	3rd Sample	1st Sample	3rd Sample	1st Sample	2nd Sampl
Communicate with researchers in your own organization	6.8	7.0	6.8	6.5	7.0	6.75
Communicate with local researchers	5.6	5.0	5.0	4.0	3.5	3.625
Communicate with national researchers	4.6	4.5	5.0	3.625	4.0	3.125
Communicate with international researchers	1.0	1.0	1.4	1.125	1.0	1.125
Communicate with researchers in other disciplines	4.6	5.5	4.8	3.875	6.0	4.250
Work at home	4.8	3.5	4.0	3.875	5.5	5.125
Work outside of normal office hours	6.0	5.5	5.8	5.875	6.0	6.0
Read work-related literature	6.75	7.0	7.0	5.875	7.0	5.750
Exchange letters with other researchers	5.2	5.0	4.8	2.5	4.5	2.7
Use the telephone to communicate with other researchers	6.0	6.0	6.2	5.5	7.0	5.3
Travel for discussions with other researchers	2.4	2.0	2.8	2.375	3.0	2.375
Other communication	5.0	5.0	3.5	3.833	3.0	3.5
How satisfied are you with communication with distant researchers?	2.8	3.0	2.4	2.875	2.5	3.250

ACTUAL CHANGE IN QUESTIONNAIRE RESPONSES
(BY INDIVIDUALS) FOR LOW-USAGE GROUPS

How frequently do you do each of the following:	Change between 1st and 2nd questionnaire		Change between 2nd and 3rd questionnaire		Change between 1st and 3rd questionnaire	
	Average Change	Signifi-cance	Average Change	Signifi-cance	Average Change	Signifi-cance
Communicate with researchers in your own organization			.25	82.4		
Communicate with local researchers			-.375	82.4	-1.5	89.7
Communicate with national researchers	.4	81.3	-.5	79.7	-.5	75.0
Communicate with international researchers	.4	99.9				
Communicate with researchers in other disciplines			.375	82.4	.5	75.0
Work at home	-.8	95.1	1.25	93.5	2.0	99.9
Work outside of normal office hours					.5	99.7
Read work-related literature	.25	99.9				
Exchange letters with other researchers	-.4	81.3	.25	82.4	-.5	99.7
Use the telephone to communicate with other researchers	.2	99.9			1.0	99.7
Travel for discussions with other researchers	.4	76.1			1.0	99.7
Other communication	-1.5	99.7			-2.0	99.9
How satisfied are you with communication with [illegible]tant researchers?			.375	90.1	-.5	99.7

BIBLIOGRAPHY

Allen, Thomas J., "Communication Networks in R&D Laboratories," *R&D Management*, vol. 1, no. 1, 1970, pp. 14-21.

Allen, Thomas J., "Roles in Technical Communication Networks," *Communication among Scientists and Engineers*, Lexington, MA: D. C. Heath & Co., 1970, pp. 191-208.

Allen, Thomas J. and Peter G. Gerstberger, "A Field Experiment to Improve Communications in a Product Engineering Department: The Nonterritorial Office," *Human Factors*, 1973, pp. 487-98.

Allen, Thomas J. and Alan R. Fusfeld, "Design for Communication in the Research and Development Lab," *Technology Review*, May 1976, pp. 65-71.

Allen, Thomas J., James M. Piemeier, and S. Cooney, "The International Technological Gatekeeper," *Technology Review*, vol. 73, no. 5, March 1971, p. 36.

Allison, David, *The R&D Game: Technical Men, Technical Managers, and Research Productivity*, Cambridge, MA: The MIT Press, 1969, pp. 56-72.

American Psychological Association, *The American Psychologist*, vol. 21, no. 11, November 1966.

Andrews, Frank M., "Contacts with Colleagues and Scientific Performance," *Discovery*, October 1966.

Andrews, Frank M. and George F. Farris, "Time Pressure and Performance of Scientists and Engineers: A Five-Year Panel Study," *Organizational Behavior and Human Performance*, vol. 8, no. 2, October 1972, pp. 185-200.

Barnes, L. B., "Organizational Change and Field Experiments Methods," in Victor H. Vroom, ed., *Methods of Organizational Research*, Pennsylvania: University of Pittsburgh Press, 1967, pp. 77-111.

Bavelas, Alex, "Communication Patterns in Task Groups," *Journal of Acoustical Society of America*, vol. 22, 1950, pp. 725-30.

Becker, Howard, "The Group: General Aspects," *Systematic Sociology on the Basis of the Beziehungslehre and Gebildelehre of Leopold von Wiese*, New York: John Wiley & Sons, Inc., 1932, pp. 488-505.

Bennett, John L., *User Acceptance of Decision Support Systems: The Role of an Integrating Agent*, Thomas J. Watson Research Center, IBM, Yorktown Heights, New York 10598, Report No. RJ 1502, January 22, 1975.

Bernard, Jessie, Charles W. Shilling, and Joe W. Tyson, *Informal Communication Among Bioscientists*, Biological Sciences Communication Project, The George Washington University, Washington, DC, BSCP Communique No. 16-63, December 1963.

Biderman, Albert D. and Thomas F. Drury, eds., *Measuring Work Quality for Social Reporting*, New York: Halsted Press Division, John Wiley & Sons, 1976.

Campbell, Donald T., "Reforms As Experiments," *American Psychologist*, vol. 24, no. 4, 1969.

Campbell, Donald T. and Julian C. Stanley, *Experimental and Quasi-Experimental Designs for Research*, Chicago: Rand McNally & Company, 1963.

Carlisle, James H., "Evaluating the Impact of Office Automation on Top Management Communication," *Proceedings of the National Computer Conference, 1976*, Office Systems Planning Corporation, Marina Del Rey, California 90291, pp. 611-6.

Conrath, David W., "Communications Environment and Its Relationship to Organizational Structure," *Management Science*, vol. 20, no. 4, December, Part II, 1973, pp. 586-603.

Cook, Thomas D. and Donald T. Campbell, "The Design and Conduct of Quasi-Experiments and True Experiments in Field Settings," in M. D. Dunnette, ed., *Handbook of Industrial and Organizational Research*, New York: Rand McNally, 1976, pp. 223-326.

Crane, Diana, "Social Structure in a Group of Scientists: A Test of the 'Invisible College' Hypothesis," *American Sociological Review*, vol. 34, June 1969, pp. 335-52.

Croston, J. D. and H. B. Goulding, "The Effectiveness of Communication at Meetings: A Case Study," *Operational Research Quarterly*, vol. 17, no. 1, 1967, pp. 47-57.

Darley, John G., Neal Gross, and William C. Martin, "Studies in Group Behavior: Factors Associated with the Productivity of Groups," *Journal of Applied Psychology*, vol. 36, 1952, pp. 396-403.

Davis, James H., *Group Performance*, Reading, MA: Addison-Wesley Publishing Company, 1969.

Day, Lawrence H., *Telecommunications and Productivity*, Bell Canada, Montreal, Quebec, Business Planning Paper #46, August 1974.

Farris, G. F., "Organizational Factors and Individual Performance: A Longitudinal Study," *Journal of Applied Psychology*, 1969, pp. 87-92.

Foraker, Alvan G., "A Research Productivity Index," *Arch Path*, vol. 93, 1972, pp. 281-2.

General Purpose Computer Networks and Resource Sharing in ERDA, Volume 3: Remote Resource Sharing Experience and Findings, Working Group on Computer Networking, Mathematical and Computer Sciences, Office of Engineering, Mathematical and Geosciences, Division of Basic Energy Sciences, ERDA.

Gerstberger, Peter G. and Thomas J. Allen, "Criteria Used by Research and Development Engineers in the Selection of an Information Source," *Journal of Applied Psychology*, vol. 52, no. 4, 1968, pp. 272-9.

Gerstenfeld, Arthur, *Effective Management of Research and Development*, Addison-Wesley Publishing Company, 1970.

Gibb, Jack R., "The Effects of Group Size and of Threat Reduction Upon Creativity in a Problem-Solving Situation," *The American Psychologist*, vol. 6, 1951, p. 324.

Guetzkow, H. and H. A. Simon, "The Impact of Certain Communication Nets Upon Organization and Performance in Task Oriented Groups," *Management Science*, vol. 1, 1955; pp. 233-50.

Hare, A. Paul, Edgar F. Borgatta, and Robert F. Bales, *Small Groups*, New York: Alfred A. Knopf, 1966.

Hiltz, R. and M. Turoff, *The Network Nation*, Addison-Wesley, forthcoming.

Hiltz, Starr Roxanne, "Communications and Group Decision-Making: Experimental Evidence on the Potential Impact of Computer Conferencing," New Jersey Institute of Technology, Draft Report, August 1975.

Hiltz, Starr Roxanne and Murray Turoff, "Potential Impacts of Computer Conferencing Upon Managerial and Organizational Styles," submitted to *Interfaces*, 1976.

Holsti, Ole R., *Content Analysis for the Social Sciences and Humanities*, Reading, MA: Addison-Wesley Publishing Company, 1969.

Hymes, Dell, *Ethnographic Monitoring*, Graduate School of Education, University of Pennsylvania, March 1976.

Johansen, Robert, *Pitfalls in the Social Evaluation of Teleconferencing Media*, Institute for the Future, Paper R-18, prepared for the Second Annual International Communications Conference, "The Status of the Telephone in Education," May 27-28, 1976.

Johansen, Robert and Jacques Vallee, *Impact of a Computer-Based Communications Network on the Working Patterns of Researchers*, Institute for the Future, Paper P-46, presented at the American Sociological Association Annual Meeting, August 1976.

Johansen, Robert, Richard H. Miller, and Jacques Vallee, "Group Communication Through Electronic Media: Fundamental Choices and Social Effects," *Educational Technology*, August 1974, pp. 7-20.

Johansen, Robert, Jacques Vallee, and Michael Palmer, *Computer Conferencing: Measurable Effects on Working Patterns*, Institute for the Future, Paper P-44, prepared for the National Telecommunication Conference of the Institute for Electrical and Electronic Engineers, November 29-December 1, 1976.

Johansen, Robert, Jacques Vallee, and Kathleen Spangler, *Electronic Meetings: Technical Alternatives and Social Choices in Teleconferencing*, Reading, MA: Addison-Wesley Publishing Company, forthcoming in 1978.

King, D. W., D. D. McDonald, N. K. Roderer, and B. L. Wood, *Statistical Indicators of Scientific and Technical Communication, 1960-1968, Volume 1*, King Research, Inc., Rockville, Maryland, approximately 1976. Available from the U.S. Government Printing Office, Washington, DC 20402, Stock No. 038-000-00295-3, $2.05.

Lamm, Helmut and Giseler Trommsdorff, "Group vs. Individual Proficiency (Brainstorming): A Review," *European Journal of Social Psychology*, vol. 3, no. 4, 1973, pp. 361-88.

Lawler, Edward E. and Douglas T. Hall, "Relationship of Job Characteristics to Job Involvement, Satisfaction, and Intrinsic Motivation," *Journal of Applied Psychology*, vol. 54, no. 4, 1970, pp. 305-12.

Lawler, Edward E., Douglas T. Hall, and Greg R. Oldham, "Organizational Climate: Relationship to Organizational Structure, Process, and Performance," *Organizational Behavior and Human Performance*, vol. 11, no. 1, 1974, pp. 139-55.

Leavitt, H. J., "Some Effects of Certain Communication Patterns on Group Performance," *Journal of Abnormal and Social Behavior*, vol. 46, 1951, pp. 38-50.

Lofland, John, *Disciplined Abstractions in Qualitative Research*, University of California, Davis, September 2, 1976.

Lorge, Irving, David Fox, Joel Davitz, and Marlin Bremner, "A Survey of Studies Contrasting the Quality of Group Performance and Individual Performance, 1920-1957," *Psychological Bulletin*, vol. 55, 1958, pp. 337-72.

Lyle, Jack, "Communication, Group, Atmosphere, Productivity, and Morale in Small Task Groups," *Human Relations*, vol. 14, 1961, pp. 369-80.

Maier, Norman R. F., "Assets and Liabilities in Group Problem Solving: The Need for an Integrative Function," *Psychological Review*, vol. 74, no. 4, July 1967, pp. 239-49.

Mann, William C., James A. Moore, James A. Levin, and James H. Carlisle, *Observation Methods for Human Dialogue*, Information Sciences Institute, University of Southern California, Marina Del Rey, California 90291, Report ISI/RR-75-33, June 1975.

McCarrey, Michael W. and Shirley A. Edwards, "Organizational Climate Conditions for Effective Research Scientist Role Performance," *Organizational Behavior and Human Performance*, vol. 9, 1973, pp. 430-59.

McGrath, Joseph E. and Irwin Altman, *Small Group Research*, New York: Holt, Rinehart and Winston, Inc., 1966.

Menzel, H., "Scientific Communication: Five Themes from Social Science Research," *American Psychologist*, vol. 21, 1966, pp. 999-1004.

Mintzberg, Henry, "Managerial Work: Analysis from Observation," *Management Science*, vol. 18, no. 2, October 1971, pp. B97-B110.

Mintzberg, Henry, "The Manager's Job: Folklore and Fact," *Harvard Business Review*, July-August 1975.

Mintzberg, Henry, *The Nature of Managerial Work*, New York: Harper and Row, 1973.

Moos, R. H. and J. C. Speisman, "Group Compatibility and Productivity," *Journal of Abnormal and Social Psychology*, vol. 65, 1962, pp. 190-6.

Mortensen, C. David, *Communication: The Study of Human Interaction*, New York: McGraw-Hill Book Company, 1972.

Morton, Jack, "From Research to Technology," in David Allison, ed., *The R&D Game*, Cambridge, MA: The MIT Press, 1969.

Nelson, Carnot E. and Donald K. Pollock, eds., *Communication Among Scientists and Engineers*, Lexington, MA: Heath Lexington Books, 1970.

O'Brien, Gordon, *Methods of Analyzing Group Tasks*, Department of Psychology, University of Illinois, Urbana, Illinois, Technical Report No. 46, January 1967.

Parker, E. B., W. J. Paisley, and R. Garrett, *Bibliographic Citations As Unobtrusive Measures of Scientific Communication*, Institute for Communication Research, Stanford University, 1967.

Pelz, D. C., "Some Social Factors Related to Performance in a Research Organization," *Administration Science Quarterly*, 1956.

Pelz, D. C., "What It Takes to Make a Problem Solver Productive," *Innovation*, no. 9, 1970, pp. 2-13.

Pelz, Donald C. and Frank M. Andrews, *Scientists in Organizations: Productive Climate for Research and Development*, New York: John Wiley and Sons, Inc., 1966.

Pye, Roger and Ederyn Williams, "Is Video Valuable or Is Audio Adequate?," *Telecommunications Policy*, June 1977.

Pye, Roger, Brian Champness, Hugh Collins, and Stephen Connell, *The Description and Classification of Meetings*, Communications Studies Group, London, England, P/73160/PY, June 1973.

Raven, Bertram H., *Group Performance*, University of California, Los Angeles, February 1, 1965.

Rubenstein, Albert H., Richard T. Barth, and Charles F. Douds, "Ways to Improve Communications Between R&D Groups," *Research Management*, November 1971, pp. 49-59.

Schachter, S., N. Ellertson, Dorothy McBride, and Doris Gregory, "An Experimental Study of Cohesiveness and Productivity," *Human Relations*, vol. 4, 1951, pp. 229-38.

Scientific and Technical Communication, National Academy of Sciences-National Academy of Engineers, Washington, DC, 1969.

Seashore, S. E., "Field Experiments With Formal Organizations," *Human Organization*, vol. 23, Summer 1964, pp. 164-70.

Shaw, Marvin E., "Communication Networks," in Berkowitz and Leonard, eds., *Advances in Experimental Social Psychology*, New York: Academic Press, 1964, pp. 111-47.

Shaw, Marvin E., *Group Dynamics, The Psychology of Small Group Behavior*, New York: McGraw-Hill, Inc., 1971.

Simmel, George, *Sociology*, translated by Kurt W. Wolf, New York: Free Press, 1950.

Smith, Clagett G., "Scientific Performance and the Composition of Research Teams," *Administrative Science Quarterly*, 1971, pp. 486-95.

Stabell, Charles B., *The Organization As an Information Processor: A Note on the Determinants of Information Processing Capacity*, Graduate School of Business, Stanford University, Stanford, California, August 1976.

Steiner, Ivan D., *Group Processes and Productivity*, New York: Academic Press, 1972.

Stogdill, Ralph M., "Group Productivity, Drive, and Cohesiveness," *Organizational Behavior and Human Performance*, vol. 8, 1972, pp. 26-43.

Stogdill, Ralph M., *Individual Behavior and Group Achievement*, New York: Oxford University Press, 1959.

Taylor, Calvin W. and Frank Barron, eds., *Scientific Creativity: Its Recognition and Development*, New York: John Wiley and Sons, Inc., 1963.

Thompson, Paul H. and Gene W. Dalton, "Are R&D Organizations Obsolete?," *Harvard Business Review*, November-December 1976, pp. 105-16.

Turoff, Murray, "Delphi Conferencing: Computer-Based Conferencing With Anonymity," *Technological Forecasting and Social Change*, no. 2, 1972.

Turoff, Murray, "The Future of Computer Conferencing," *The Futurist*, vol. 9, no. 4, August 1975.

Turoff, Murray and Roxanne Hiltz, "Meeting Through Your Computer," *IEEE Spectrum*, May 1977, pp. 58-64.

Vallee, Jacques, *The Outlook for Computer Conferencing on ARPANET and PLATO*, prepared for the Society for General Systems Research meetings, February 1977. Available from the Institute for the Future.

Vallee, Jacques and Gerald Askevold, "Geologic Applications of Network Conferencing: Current Experiments With the FORUM System," in Peter Lykos, ed., *Computer Networking and Chemistry*, American Chemical Society, Washington, DC, 1975, pp. 53-66.

Vallee, Jacques and Thaddeus Wilson, *Computer-Based Communication in Support of Scientific and Technical Work*, Institute for the Future, NASA Report No. CR 137879, March 1976.

Vallee, Jacques, Robert Johansen, and Kathleen Spangler, "Computer Conferencing: An Altered State of Communication?," *The Futurist*, June 1975; reprinted in *People's Computers*, September-October 1977.

Vallee, Jacques, Hubert M. Lipinski, and Richard H. Miller, *Group Communication Through Computers, Volume 1: Design and Use of the FORUM System*, Institute for the Future, Report R-32, July 1974.

Vallee, Jacques, Robert Johansen, Hubert Lipinski, and Thaddeus Wilson, *Group Communication Through Computers, Volume 4: Social, Managerial, and Economic Issues*, Institute for the Future, forthcoming.

Vallee, Jacques; Robert Johansen; Robert H. Randolph; and Arthur C. Hastings, Consultant; *Group Communication Through Computers, Volume 2: A Study of Social Effects;* Institute for the Future; Report R-33; November 1974.

Vallee, Jacques; Robert Johansen; Hubert Lipinski; Kathleen Spangler; Thaddeus Wilson; and Andrew Hardy, Consultant; *Group Communication Through Computers, Volume 3: Pragmatics and Dynamics;* Institute for the Future; Report R-35; October 1975.

Watson, James D., *The Double Helix,* New York, NY: The New American Library, Inc., 1968.

Whitehead, Alfred North, *Science and the Modern World,* New York: Free Press, 1925.

Zagona, Salvatore V., Joe E. Willis, and William J. MacKinnon, "Group Effectiveness in Creative Problem Solving Tasks: An Examination of Relevant Variables," *Journal of Psychology,* vol. 62, 1966, pp. 111-37.

Zinn, Karl L., Robert Parnes, and Helen Hench, "Computer-Based Educational Communications At the University of Michigan," *Proceedings of the Association of Computer Machinery (ACM) National Conference,* Houston, Texas, October 20-22, 1976.